ENDANGERED SPECIES ACT - SECTION 7

BIOLOGICAL OPINION

UNLISTED SPECIES ANALYSIS, AND SECTION 10 FINDINGS

for Proposed Issuance of a Section 10 Incidental Take Permit to the Simpson Timber Company, for the Northwest Timberlands Habitat Conservation Plan

Agency: National Marine Fisheries Service

Consultation
Conducted By: National Marine Fisheries Service
Northwest Region
Washington State Branch Office

Approved Joe Scordino Date 10/13/00
Joe Scordino
Deputy Regional Administrator

Reference: NMFS WSB 99-593

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I. BACKGROUND

This document constitutes the National Marine Fisheries Service (NMFS) Biological Opinion (Opinion), Unlisted Species Analysis, and Findings prepared pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act). This document describes the potential effects of issuing a proposed incidental take permit to Simpson Timber Company (Simpson) for up to 5 species of listed and unlisted Pacific salmon for a period of 50 years, pursuant to section 10(a)(1)(B) of the Act. This Opinion is based on the NMFS and United States Fish and Wildlife Service (USFWS, together the Services) separate and collaborative reviews of the conservation, minimization, and mitigation measures proposed in the Simpson Timber Company, Northwest Timberlands Multi-Species Habitat Conservation Plan (final HCP) and Implementing Agreement (IA), for 105,859 hectares (261,575 acres) of timberlands located in Mason, Grays Harbor, and Thurston counties, Washington.

The proposed incidental take of up to 51 listed and unlisted species (the total number of HCP-covered species) would occur as the result of on-going mechanized timber harvest, log transportation, road construction, maintenance, and decommissioning, site preparation and slash abatement, tree planting, fertilization, silvicultural thinning, experimental silviculture, wildfire suppression, vertebrate control, stream restoration, research and monitoring (including electrofishing), and harvest and management of minor forest products including firewood, floral brush, mushrooms and ferns consistent with the final HCP and Implementation Agreement (IA) (STC July, 2000). Note that the USFWS is preparing a companion Biological Opinion/Conference Opinion on the subject section 10 permit application for coverage of 46 aquatic and terrestrial species under its purview (USFWS October 2000), and will be evaluating a separate incidental take permit application from Simpson.

This Opinion considers the potential effects and incidental take of the proposed action on two listed Pacific salmon species: 1) the threatened Puget Sound chinook salmon Evolutionarily Significant Unit (ESU) (*Oncorhynchus tshawytscha*) and, 2) the threatened Hood Canal summer-run chum salmon ESU (*O. keta*). Also considered are two candidate coho salmon ESUs (*O. kisutch*): 1) the Puget Sound/Straight of Georgia coho ESU, and 2) the Lower Columbia River/Southwest Washington coho ESU. In addition five unlisted Pacific salmon ESUs are present in the Plan Area and are addressed in this Opinion: 1) chinook salmon - Pacific Coast ESU, 2) chum salmon - Pacific Coast ESU, 3) pink salmon (*O. gorbuscha*) - odd year ESU,

4) steelhead trout (*O. mykiss*) - the Southwest Washington ESU, and 5) the steelhead trout - Puget Sound ESU. Together, these seven candidate and unlisted species ESUs are considered in this Opinion under the Services' No Surprises Policy (63 Fed. Reg. 8859) and fulfilling the Service's commitments specified in the IA (STC July 2000) should these ESUs, or future modifications thereof, require protection of listing under the ESA.

NMFS concludes that the proposed action is not likely to jeopardize the subject species, or destroy or adversely modify designated critical habitat. Included in this Opinion is an incidental take statement. This consultation is conducted pursuant to section 7(a)(2) of the ESA and its implementing regulations, 50 CFR 402.

A. Consultation History

From 1997 to present, the Services provided technical and policy assistance to Simpson that resulted in completion of a final HCP. Between April, 1997 and November, 1998, at least 46 meetings were held among the Services, Simpson and the following agencies, Tribes and organizations: Environmental Protection Agency (EPA), Washington Department of Natural Resources (DNR), Washington Department of Fish and Wildlife (WDFW), Washington Department of Ecology (DOE), National Audubon Society (NAS), Washington Environmental Council (WEC), Skokomish Indian Tribe (SKOK), Squaxin Island Indian Tribe (SQAX), Quinault Indian Tribe (QIN), Point No Point Treaty Council (PNPTC), and Northwest Indian Fisheries Commission (NWIFC). Appendix H of the HCP lists contributors to this effort. In addition, numerous field trips were held for these participants to give them perspectives of the Plan Area and the proposed management actions. More than 200 additional discussions were held among these participants via phone calls, faxes, and e-mails. The Services prepared a Species List of threatened, endangered and proposed species known to occur in the proposed Plan Area on December 3, 1998 (USFWS Reference: 1-3-99-SP-0061). This list was provided to Resources Northwest Consultants, on behalf of Simpson.

The Public Review Draft National Environmental Policy Act (NEPA) Environmental Impact Statement (DEIS) for the HCP was made available for a 62-day public comment period on October 26, 1999. The comment period was extended for 18 days to January 14, 2000 (65 Fed. Reg. 761), in response to requests from the public and concerns by the Services that the public would have inadequate opportunity to comment because of the holiday season. This resulted in a total comment period duration of 80 days. The Services also solicited comments via letters mailed directly to individuals and organizations included and on the Service's public notification mailing list. The Services also advertised this comment period and extension by distributing news releases to newspapers, and radio and television stations in western Washington.

The Services and Simpson prepared a Final EIS (FEIS) on the Draft HCP (USFWS and NMFS 2000) and a Response to Public Comments on the Public Review Draft EIS (USFWS and NMFS 2000). These two documents were made available to the public on July 21, 2000. The Services have addressed public, tribal and agency concerns raised about the Draft HCP and discussed alternative approaches with Simpson.

Summarily, this Opinion and Findings is based: on Simpson's final HCP and IA; amended technical appendices, including a TMDL Technical Assessment Report; the Services' FEIS and Response to Public Comments on the DEIS; several years of discussions and negotiations with Simpson Timber Company and State agencies; site visits and meetings with local and regional stakeholders, particularly tribal governments; a workshop evaluation of the HCP stream classification system by regional experts; technical reports; published literature cited or incorporated by reference; and the local knowledge and experience of the Service's project biologists. A complete administrative record of this HCP is on file in the NMFS Washington State Branch Office, Lacey, Washington.

II. PROPOSED ACTION

Simpson (applicant) has prepared a multi-species HCP and applied for a section 10(a)(1)(B) incidental take permit (ITP) to comply with the Act and to address commercial timber harvest activities described below. The proposed 50-year HCP and ITP would cover 105,859 hectares (261,575 acres) of Simpson's lands (Plan Area), primarily within the Chehalis River drainage in Mason and Grays Harbor counties, in northwestern Washington.

Only actions specifically described in the HCP, IA, and ITP, occurring inside the Plan Area or within the 630,000 acre assessment area that includes the Plan Area and lands that Simpson may acquire or wish to include in the future, are covered by this Opinion. Actions occurring outside this area, or actions not specifically described within the HCP, IA, and ITP, with potential for take of listed species, would be need to be addressed by separate formal consultation or HCP permitting process under the Act.

As part of the subject action, Simpson has applied for an ITP for take of listed species currently or potentially found on site. For unlisted species specified in the final HCP, the proposed ITP would have a delayed effective date or dates, and authorization of incidental take would become effective if and when one of these currently unlisted species is listed.

More detailed descriptions and provisions of the proposed action can be found in the Final HCP (Sections 5, 6, 10, and 12) and IA (STC, July 2000).

A. HCP Plan Area

The proposed Plan Area and potentially added lands stretch across most of the southern end of the Olympic Peninsula from near Aberdeen and the Quinault Indian Reservation off the Pacific Ocean to the west, to Puget Sound near Olympia and Shelton to the east, north to Hood Canal, Lake Cushman, and Wynoochee Lake bordering the Olympic National Forest, and south to just beyond the State Highway 8 and Capitol State Forest. This area includes approximately 422 miles of stream actually or potentially supporting anadromous salmonids, and 976 miles of stream classified as non-fishbearing (Table 3 in the HCP, STC July 2000).

B. Summary of HCP Actions

The Simpson Timber Company final HCP, which is incorporated herein by reference, provides mitigation and minimization measures associated with an ITP for two federally listed species regulated by NMFS, the Puget Sound chinook and Hood Canal summer chum salmon. The HCP also conserves habitat for the covered and currently unlisted species in the Plan Area. The measures described in the HCP include addressing habitat requirements and minimizing, mitigating and monitoring the impacts of covered activities on runs of anadromous salmonids and other species that are candidates for listing by the Federal government. Foremost, the HCP would (1) apply a riparian conservation strategy within a geomorphic stream classification system, 2) manage the production and routing of sediments to aquatic systems through a suite of road inventory and remediation measures, avoiding harvest on unstable slopes, and implementation of water quality measures by stream class, 3) apply specific prescriptions to restore hydrologic immaturity, and 4) provide a robust research and monitoring to address important uncertainties; to evaluate effectiveness of mitigation, compliance with the plan, and trends in habitats and key species; and to provide for adaptive management. The complete conservation program is explained in Section 6 of the HCP (STC July 2000).

Specific agreements have been developed by Simpson Timber with the EPA and the DOE to implement a water quality program under the Clean Water Act. This program is a set of Total Maximum Daily Loads (TMDLs) for heat energy and sediment, specific to each stream class, that are integral and supplemental to the conservation benefits provided through the HCP. The TMDL Technical Assessment Report is provided as Appendix G in the HCP (STC July 2000) and is incorporated herein by reference. While the authorities and agencies responsible for implementing the Clean Water Act and the ESA are separate, the NMFS considers the technical analysis and commitment of Simpson Timber Company to implement and adapt this water quality program to be additional assurances to conserve anadromous salmonids and their habitats.

C. Covered Activities

Simpson Timber Company intends to continue to manage the 105,859-hectare (261,575-acre) Plan Area as commercial forest. Simpson Timber has committed to a specific conservation plan for a list of species proposed for incidental take coverage (Covered Species) within the final HCP. The HCP is not an HCP for planned development, but rather it is a set of mitigation and conservation commitments related to proposed management and operations of commercial forest lands.

Proposed covered activities are described in the HCP (Section 1.5). They are specified as operations in the Plan Area inherent to commercial forest operations and the monitoring and implementation of the HCP, summarily: on-going mechanized timber harvest, log transportation, road construction, maintenance, and decommissioning, site preparation and slash abatement, tree planting, fertilization, silvicultural thinning, experimental silviculture, wildfire suppression, vertebrate control, stream restoration, research and monitoring, electrofishing, and harvest and management of minor forest products including firewood, floral brush, mushrooms and ferns.

D. Action Area

The action area for this Opinion, per 50 CFR § 402.02, includes "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." In this case, the proposed Federal action is issuing the ITP for the action described in the final HCP. The project direct footprint includes the Plan Area, approximately 105,859 hectares (261,575 acres), plus the 630,000 acre Assessment Area that could potentially be added to the ITP (per Section 10 of the IA). The action area for the subject HCP includes the Plan Area, lands potentially added for coverage, and surrounding lands potentially indirectly affected by the action.

A detailed description of the action area is provided in the FEIS prepared by the Services (USFWS and NMFS, July 2000). Because of potential erosion, sedimentation, siltation, water temperature, and hydro-geomorphic effects, the action area includes whole watersheds/drainages which contact the Plan Area. Since indirect effects include instream flows in various large rivers and streams (see Figure 3.1 in the EIS, and Figure 1 in the HCP), the action area includes these contacted drainages downstream to the Pacific Ocean, Hood Canal, and South Puget Sound.

Simpson is requesting coverage for additional lands that they might acquire in the action area, outside of the Plan Area. Although undetermined within the final HCP, these lands (Assessment Area) roughly total an additional 250,000 hectares (630,000 acres) surrounding the Plan Area. These lands are not owned by Simpson, but some (likely a small portion) may be acquired by them in the future. These lands are not described within the final HCP in detail, except that they are expected to be described by the geomorphic stratifications within the Plan Area and would be, with concurrence of the Services, appropriately managed under the prescriptions, programs, and adaptations of the final HCP and IA (STC July 2000). These lands are considered potentially affected by the proposed action, because the addition of these lands is conditionally authorized and directed by the IA. Thus, proposed "lands eligible for inclusion" which surround the Plan Area (see Section 10.0 and Exhibit A of the IA, and Figure 2 of the HCP), are part of the proposed action analyzed herein.

E. Changed and Unforeseen Circumstances

1. <u>Foreseeable Changed Circumstances</u>

The relationship between fire, flood, and other physical and biological processes (disturbance) in the structure and composition of forest communities and stream systems has been appreciated for a considerable period of time (See, for example, Franklin and Dyrness 1973; Brown 1985; Henderson et. al. 1989; Morrison and Swanson 1990; Agee 1991, Reeves et. al. 1995). Disturbances that affect the biodiversity and landscape ecology of Simpson's lands are usually of moderate intensity and relatively confined in geographic extent and magnitude of impact, but may significantly alter stream and forest habitats. Disturbance, in general, has been a substantive consideration in the development of the HCP. Foremost, the intent of the HCP is to minimize management-related disturbances and create conditions that enable natural disturbances to create productive habitat.

Certain reasonably foreseeable disturbances, however, may be of such a magnitude, occur with such an "impulse", or impact such particular portions of the Plan Area as to require the application of supplemental prescriptions for the protection of the covered species. These changed circumstances and supplemental prescriptions are described in Appendix F of the HCP (STC July 2000):

1. **Fire**. (Acreage and location specifications, salvage of downed timber, residual forest structure, reforestation.)

2. **Wind**. (100 meter riparian blow-down threshold, salvage of downed timber, residual forest structure, reforestation.)

3. **Landslides**. (10,000 cubic meter delivery threshold, analysis, Services' notification, Adaptive Management.)

4. **Floods**. (Considered part of the Riparian Conservation Reserve and prescriptions.)

5. **Insect Infestations**. (Confer with Services, salvage of downed timber, residual forest structure, reforestation.)

6. **Swiss Needle Cast** (20 percent infestation threshold, see 1..)

7. **Ice and Severe Cold Weather** (10,000 acre threshold, see 1.)

8. **Earthquake**. (Primarily considered as part of 3, above.)

9. **Pending Lawsuit - Cooperative Sustained Yield Unit (CSYU)**. (Supplemental or changed prescriptions to be determined per litigation.)

Changed circumstances could come about as a result of Simpson Timber Company prevailing in litigation against the United States (U.S. Court of Federal Claims, Case No. 00-198C; U.S. District Court (Tacoma), Case No. C00-5207-RJB) that causes timber in the CSYU to be made available for harvest by the Company. The CSYU consists of lands to the north and generally upstream of the Plan Area that are managed by the Olympic National Forest under a 1946 agreement with Simpson Timber Company. Since 1994 these lands have come under management of the Northwest Forest Plan (USDA 1994), allowing the Services to assume that trends in habitat quality and distribution in the CSYU will be positive and complimentary to the Plan Area. Should litigation cause these assumptions to change, the Services will examine potential changes to their respective Biological Opinions and other associated analyses and confer with Simpson Timber on possible remedies, per the Implementing Agreement.

Changed circumstances will not be deemed "adaptive management" for purposes of this Plan and the costs of implementing such measures will not be considered an adaptive management "cost" in terms of acreage or dollars (see Section 10 of the HCP and Section C, above).

2. Unforeseen Circumstances

Unforeseen circumstances are those changes in habitats, conditions, or species status that could not be reasonably anticipated at issuance of the ITP. These circumstances are generally described in the Services' "No Surprises Policy" (63 Fed. Reg. 8859) and are incorporated in the IA (Section 11.4(c).

III. SPECIES STATUS OF ANADROMOUS FISH SPECIES COVERED UNDER THE HCP

A. ESA Status of the Anadromous Fish Species

Thirty aquatic species and 21 wildlife species have been proposed for coverage and conservation under the ESA through the provisions of the HCP and IA (Tables 1 and 2, STC 2000). The aquatic species have been classified by five "Species Associations" described in the HCP: Headwater, Steep Tributary, Flat Tributary, Mainstem, and Lentic. The nine listed, candidate, or unlisted ESUs of Pacific salmon affected by this action are primarily included in the Flat Tributary and Mainstem Species Associations. These salmon ESUs are listed in Table 1 along with their pertinent history of ESA decisions, designations of critical habitat, and status reviews. The effects of the proposed action on all other aquatic and wildlife species are addressed in the USFWS Biological Opinion and Conference Report (USFWS October 2000).

Table 1. Status, history of listing and critical habitat designations under the ESA, and pertinent status reviews for nine Pacific salmon ESUs occurring within the Simpson HCP action area.

[redacted]				
[redacted]	63 Fed. Reg. 11482 March 9, 1998	64 Fed. Reg. 14308 March 24, 1999 / 65 Fed. Reg. 7764 Feb. 16, 2000.	**Threatened**	Myers *et al.* 1998
[redacted]		63 Fed. Reg. 11482 March 9, 1998	Not Warranted	Myers *et al.* 1998
[redacted]	63 Fed. Reg. 1174 March 10, 1998	64 Fed. Reg. 14508 March 25, 1999 / 65 Fed. Reg. 7764 Feb. 16, 2000.	**Threatened**	Johnson *et al.* 1997
[redacted]		63 Fed. Reg. 1174 March 10, 1998	Not Warranted	Johnson *et al.* 1997

[redacted]		62 Fed. Reg. 37560 July 14, 1997	Candidate	Weitkamp *et al.* 1995
[redacted]		62 Fed. Reg. 37560 July 14, 1997	Candidate	Weitkamp *et al.* 1995
[redacted]		60 Fed. Reg. 51928 Oct. 4, 1995	Not Warranted	Hard *et al.* 1996
[redacted]		61 Fed. Reg. 41541 August 9, 1996	Not Warranted	Busby *et al.* 1995, 1996
[redacted]		61 Fed. Reg. 41541 August 9, 1996	Not Warranted	Busby *et al.* 1995, 1996

B. Biological Information

Anadromous salmonids were historically found throughout the Plan Area that includes two major river systems, the Skokomish River and the Chehalis River. The relevant biological requirements are those necessary for those salmon species in the Plan Area (see Table 1) to survive and recover to naturally reproducing population levels at which time protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stock, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment.

Information related to biological requirements for each species may be found in Status Reviews listed in Table 1. Presently, the biological requirements of listed species are not being met under the environmental baseline. To improve the status of the listed species, significant improvements in the environmental conditions of designated critical habitat are needed.

The status of ESUs of anadromous salmonid species within the Plan Area are described below and analyzed, as warranted, in the following sections.

1. Chinook Salmon

West coast chinook salmon have been the subject of many Federal ESA actions, which are summarized in the proposed rule (63 Fed. Reg. 11482, March 9, 1998) and in a final rule for listing chinook ESUs in Washington and Oregon (64 Fed. Reg. 14308, March 24, 1999). A complete status review was conducted by the NMFS (Myers *et al.* 1998) that identified fifteen ESUs from Washington, Oregon, Idaho, and California. Based on this review, and considering efforts being made to protect chinook salmon, NMFS proposed two ESUs as endangered (Washington Upper Columbia River spring chinook and California Central Valley spring chinook) and five ESUs as threatened (Puget Sound, Lower Columbia River, Southern Oregon and California Coastal, Upper Willamette River spring, and California Central Valley fall/late-fall run chinook salmon). In addition, the Snake River fall-run chinook ESU was revised to include Deschutes River (OR) fall-run chinook salmon and the proposal made to list that ESU as threatened. Substantial scientific disagreement existed about the Snake River fall-run chinook, California Central Valley spring chinook, Southern Oregon and California Coastal, and California Central Valley fall/late-fall run chinook salmon and extended the period for making final determinations about these ESUs. After receiving additional comments and information and revising the status review of chinook salmon the NMFS made its final determinations about chinook on March 24, 1999 (64 Fed. Reg. 14308).

a. Puget Sound Chinook ESU - Threatened

This ESU encompasses all runs of chinook salmon in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula. The boundaries of the Puget Sound chinook ESU correspond generally with the boundaries of the Puget Lowland Ecoregion (see Franklin and Dyrness 1988). The Elwha River, which is in the Coastal Ecoregion, is the only system in this ESU that lies outside the Puget Sound Ecoregion. Coincidentally, the boundary between the Washington Coast and Puget Sound ESUs (which includes the Elwha River in the Puget Sound ESU) corresponds with ESU boundaries for steelhead and coho salmon.

The NMFS conducted a thorough status review of Puget Sound chinook (Myers *et al.* 1998) from which much of the following information is restated. Chinook salmon in this area all exhibit an ocean-type life history. Although some spring-run chinook salmon populations in the Puget Sound ESU have a high proportion of yearling smolt emigrants, the proportion varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Puget Sound stocks all tend to mature at ages 3 and 4 and exhibit similar, coastally-oriented, ocean migration patterns. There are substantial ocean distribution differences between Puget Sound and Washington coast stocks, with Coded Wire Tags from Washington Coast fish being recovered in much larger proportions from Alaskan waters. The marine distribution of Elwha River chinook salmon most closely resembled other Puget Sound stocks, rather than Washington coast stocks, and, considering other factors, included this stock in the

Puget Sound ESU. The NMFS concluded that, on the basis of substantial genetic separation, the Puget Sound ESU does not include Canadian populations of chinook salmon.

Overall abundance of chinook salmon in this ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high. Contributing to these reduced abundances are widespread stream blockages, which reduce access to spawning habitat, especially in upper reaches. Both long- and short-term trends in abundance are predominantly downward, and several populations are exhibiting severe short-term declines. Spring-run chinook salmon populations throughout this ESU are all depressed.

(1) Life History

Chinook salmon are the largest of the Pacific salmon. The species' distribution historically ranged from the Ventura River in California to Point Hope, Alaska in North America, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991). Additionally, chinook salmon have been reported in the Mackenzie River area of northern Canada (McPhail and Lindsey 1970). Of the Pacific salmon, chinook salmon exhibit arguably the most diverse and complex life history strategies. Healey (1986) described 16 age categories for chinook salmon, 7 total ages with 3 possible freshwater ages. This level of complexity is roughly comparable to sockeye salmon (*O. nerka*), although sockeye salmon have a more extended freshwater residence period and utilize different freshwater habitats (Miller and Brannon 1982, Burgner 1991). Two generalized freshwater life-history types were initially described by Gilbert (1912): "stream-type" chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" chinook salmon migrate to the ocean within their first year. Healey (1983, 1991) has promoted the use of broader definitions for "ocean-type" and "stream-type" to describe two distinct races of chinook salmon. This racial approach incorporates life history traits, geographic distribution, and genetic differentiation and provides a valuable frame of reference for comparisons of chinook salmon populations.

The generalized life history of Pacific salmon involves incubation, hatching, and emergence in freshwater, migration to the ocean, and subsequent initiation of maturation and return to freshwater for completion of maturation and spawning. Juvenile rearing in freshwater can be minimal or extended. Additionally, some male chinook salmon mature in freshwater, thereby foregoing emigration to the ocean. The timing and duration of each of these stages is related to genetic and environmental determinants and their interactions to varying degrees. Salmon exhibit a high degree of variability in life-history traits; however, there is considerable debate as to what degree this variability is the result of local adaptation or the general plasticity of the salmonid genome (Ricker 1972, Healey 1991, Taylor 1991). More detailed descriptions of the key features of chinook salmon life history can be found in Myers, *et al.* (1998) and Healey (1991).

This Puget Sound chinook salmon ESU encompasses all runs of chinook salmon in the Puget Sound region from the North Fork Nooksack River in the east to the Elwha River on the Olympic Peninsula. Chinook salmon in this area all exhibit an ocean-type life history. Although some spring-run chinook salmon populations in the Puget Sound ESU have a high proportion of yearling smolt emigrants, the proportion varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Puget Sound stocks all tend to mature at ages 3 and 4 and exhibit similar, coastally-oriented, ocean migration patterns.

(2) Population Trends

The 5-year geometric mean of spawning escapement of natural chinook salmon runs in North Puget Sound for 1992-96 is approximately 13,000. Both long- and short-term trends for these runs were negative, with few exceptions. In South Puget Sound, spawning escapement of the natural runs has averaged 11,000 spawners. In this area, both long- and short-term trends are predominantly positive.

The Puget Sound chinook salmon ESU is large and complex, comprising many individual, discrete populations spread among the major Puget Sound region watersheds. WDF *et al.* (1993) identified 28 stocks that were distributed among five geographic regions and 12 management units or basins (Table 2). (The Hoko River stock was included in WDF's initial inventory, but was subsequently assigned to the neighboring ESU.) NMFS is currently engaged in delineating the population structure of PS chinook and other ESUs as an initial step in a formal recovery planning effort that is now underway. These determinations have not been finalized at this time, but it is likely that these 28 stocks represent the greatest level of potential stratification and that some further aggregation of these stocks is possible.

Puget Sound includes areas where the habitat still supports self-sustaining natural production of chinook, areas where habitat for natural production has been irrevocably lost, and areas where chinook salmon were never self-sustaining. In addition, the Puget Sound contains areas where indigenous local stocks persist and areas where local stocks are a composite of indigenous stocks and introduced hatchery fish that may or may not be of local origin. In some areas where natural production has been lost, hatchery production has been used to mitigate for lost natural production. In response to these varied circumstances, the state and tribal co-managers are developing approaches to categorize stocks to provide a context for analyzing hatchery and harvest actions and considering recovery efforts.

Recently, the NMFS completed formal Section 7 consultations that considered the Skokomish chinook stock to possibly be indigenous and genetically unique, or to be persisting where indigenous stocks may no longer exist, but where sustainable stocks existed in the past and where the habitat could still support such stocks (NMFS 1999, 2000). The Skokomish stock is part of a larger group in Hood Canal and South Sound that have been managed for hatchery production and harvest for many years. Further investigations will seek to identify remnant indigenous stocks which, if found, would identify them as the most locally adaptable stock to be utilized in the reestablishment of naturally sustainable populations.

Table 2. Distribution of stocks identified in WDF *et al.* (1993). Stock timing designations are spring (SP), summer (S), fall (F), and summer/fall (SF).

Strait of Juan de Fuca	Elwha/Morse Cr./SF Dungeness/SP
Hood Canal	Westside Tribs Eastside Tribs Skokomish
Nooksack/Samish	NF Nooksack/SP SF Nooksack/SP Nooksack/F Samish R. /SF
Skagit Spring	Upper Sauk/SP Suiattle/SP Cascade/SP
Skagit Summer/Fall	Upper Skagit/S Lower Skagit/F Lower Sauk/S
Stillaguamish	Stillaguamish/S Stillaguamish/F
Snohomish	Snohomish/S Wallace/SF Snohomish/F Bridal Veil Cr/F
Lake Washington	Issaquah/SF N Lake WA Tribs/SF Cedar/SF
Duwamish/Green	Duwamish/Green/SF Newaukum Cr/SF
Puyallup	White River/SP White River/SF Puyallup River /SF S. Prairie Ck. /SF

	Nisqually	Nisqually River/SF
	South Sound Tribs	South Sound Tribs/SF

Drawing from NMFS' Biological Opinions cited above, stock status ranges from healthy to critical; some stocks are severely limited by the available habitat. The range of hatchery influence varies from completely dependant to stocks that are largely unaffected by hatchery strays Circumstances pertinent to the status of each stock varies considerably. Some stocks (e.g. Dungeness and Nooksack) have fallen to such low levels that maintenance of genetic diversity may be at risk. Other stocks are more robust and the abundance levels are above what is needed to sustain genetic diversity, but often not at levels that will sustain maximum yield harvest rates. All of these stocks have escapement goals, which are actively managed for, but have not generally been achieved in recent years. In some cases (Elwha, Dungeness, Nooksack, Stillaguamish, and White River) hatchery operations are essential for recovery, and without them, the stocks would likely further decline and go extinct. In one case at least (Green River) the number of hatchery fish spawning naturally is a concern, in part because it masks our ability to evaluate the actual productivity of wild fish.

2. Chum Salmon

a. Hood Canal Summer Chum ESU - Threatened Species

On March 25, 1999, Hood Canal summer chum salmon (*O. keta*) were listed as "threatened" under the ESA (64 Fed. Reg. 14508). The listed chum salmon population includes naturally spawned chum salmon residing below impassable natural barriers (e.g. long-standing natural waterfalls). After an examination of the relationship between hatchery and natural populations of summer chum salmon in the ESU, NMFS determined that none of the hatchery populations are currently essential for recovery, and therefore, the hatchery populations (and their progeny) are not listed.

(1). Life History

The following information was taken from the Co-manager's Summer Chum Salmon Conservation Initiative (WDFW and PNPTT 2000). While much of the following life history summary is based on specific information about summer chum salmon, some of the descriptive material is derived from observations made on fall chum salmon.

Adult chum salmon and sockeye salmon are distinguished from other Pacific salmon by a lack of distinct black spots on the back and caudal fin. The 19 or 20 short, stout gill rakers on the first arch of the chum salmon distinguish it from sockeye, which have 28 to 40 long, slender gillrakers (Wydoski and Whitney 1979). Juvenile chum salmon are distinguished by parr marks of relatively regular height that are smaller than the vertical diameter of the eye, and that are faint or absent below the lateral line (see WDFW and PNPTT 2000). When in spawning condition, adult chum salmon have greenish to dusky mottling on the sides, with males exhibiting distinctive reddish-purple vertical barring. Adult chum in Puget Sound range in size from 17 to 38 inches, with an average weight of 9 to 11 pounds.

One distinguishing characteristic of this group of summer chum populations is an early nearshore marine area, adult run timing (early August into October). This early timing creates a temporal separation from the more abundant indigenous fall chum stocks which spawn in the same area, allowing for reproductive isolation between summer and fall chum stocks in the region (WDF *et al.* 1993). The distance between summer chum spawning tributaries of Hood Canal and the eastern Strait of Juan de Fuca, and the rest of the Puget Sound streams, creates a geographical separation among the stocks.

Hood Canal and Strait of Juan de Fuca summer chum populations are one of three genetically distinct lineages of chum salmon in the Pacific Northwest region (Johnson *et al.* 1997). WDFW concluded that the Hood Canal and Strait of Juan de Fuca summer chum comprise a distinct major ancestral lineage, defined as stocks whose shared genetic characteristics suggest a distant common ancestry, and substantial reproductive isolation from other chum lineages (Phelps et al.1995, WDFW 1995). NMFS (Johnson *et al.* 1997) designated Hood Canal and Strait of Juan de Fuca summer chum as an evolutionarily significant unit, based upon distinctive life history and genetic traits. Genetic differences between summer chum and all other chum stocks in the U.S. and British Columbia are a result of long-standing reproductive isolation of the Hood Canal and Strait of Juan de Fuca summer chum populations (Tynan 1992). This isolation has been afforded by a significantly different migration and escapement timing, and geographic separation from other chum stocks in the Pacific Northwest (Tynan 1992, Johnson *et al.* 1997)

(2) Distribution

A total of 11 streams in Hood Canal have been identified as recently having indigenous summer chum populations: Big Quilcene River, Little Quilcene River, Dosewallips River, Duckabush River, Hamma Hamma River, Lilliwaup Creek, Union River, Tahuya River, Dewatto River, Anderson Creek, and Big Beef Creek (Tynan 1992). Summer chum are occasionally observed in other Hood Canal drainages, including the Skokomish River which was once a major summer chum stream. SASSI (WDF *et al.* 1993) lists two, distinct summer chum populations in Hood Canal - the Union River population and a group including all other Hood Canal summer production streams, but this assessment has been modified for this recovery plan. Summer chum salmon populations in the eastern Strait of Juan de Fuca have been reported in Chimacum Creek, located near Port Hadlock in Admiralty Inlet, Snow and Salmon creeks in Discovery Bay and Jimmycomelately Creek in Sequim Bay. (WDF *et al.* 1993, Sele 1995). Recent stock assessment data indicate that summer chum also return to the Dungeness River, but the magnitude of returns is unknown (Sele 1995).

Summer chum in the region use Hood Canal and the Strait of Juan de Fuca estuarine and marine areas for rearing and seaward migration as juveniles. The fish spend two to four years in northeast Pacific Ocean feeding areas prior to migrating southward during the summer months as maturing adults along the coasts of Alaska and British Columbia in returning to their natal streams. Adults may delay migration in extreme terminal marine areas for up to several weeks before entering the streams to spawn. Spawning occurs in the lower reaches of each summer chum stream.

(3) Life History Strategy

Summer chum have evolved to exploit freshwater and estuarine habitats during periods, and for durations, when interaction with other Pacific salmon species and races is minimized. The uniqueness of summer chum is best characterized by their late summer entry into freshwater spawning areas, and their late winter/early spring arrival in the estuaries as seaward-migrating juveniles.

Summer chum spawning occurs from late August through late October, generally within the lowest one to two miles of the tributaries. Depending upon temperature regimes in spawning streams, eggs reach the eyed stage after approximately 4-6 weeks of incubation in the redds, and hatching occurs approximately 8 weeks after spawning (L. Telles, Quilcene National Fish Hatchery, Quilcene, WA, pers. comm., 1996 cited in NMFS 2000). Alevins develop in the redds for additional 10-12 weeks before emerging as fry between February and the last week of May. Estimated peak emergence timings for Hood Canal and Strait of Juan de Fuca summer chum populations are March 22 and April 4 respectively. By contrast, indigenous fall chum stocks spawn in Hood Canal streams predominately in November and December, and the resulting fry emerge from the spawning gravels approximately one month later than summer chum salmon, between late April and mid-May (Koski 1975, Tynan 1997). Chum fry recovered in Hood Canal marine areas during the summer chum emergence period range in size from 35-44 mm.

(4) Freshwater Juvenile Life History

Developing chum salmon incubate as eggs or sac fry in the gravel for five or six months after fertilization, a time period determined mainly by ambient temperature regimes characteristic of Pacific Northwest streams (Bakkala 1970, Koski 1975, Schreiner 1977, Salo 1991). Stream flow, dissolved oxygen levels, gravel composition, spawning time, spawning density and genetic characteristics also affect the rate of egg/alevin development, and hence gravel residence time (Bakkala 1970, Koski 1975, Schroder 1981, Salo 1991). The earliest eggs deposited enter the tender stage starting the first week in September, with the majority of incubating eggs reaching the eyed stage by November 3. Bakkala (1970) reported total gravel residence times for chum ranging from 78 to 183 days across the range of chum salmon distribution, dependent on stream temperature. Koski (1975) documented an average gravel residence time from spawning to 50% (peak) population emergence for Big Beef Creek summer chum of 166 days, with 95 % emergence after 177 days. Telles (1996) reported 100 % emergence (swim-up) of 1994 brood Big Quilcene River summer chum 111 days after fertilization at QNFH.

Summer chum fry emergence timing in Hood Canal can range from the first week in February ("warm" years and/or earlier spawn date years) through the second week in April (colder and/or later spawn date years). The 10 %, 50 % and 90 % average emergence dates across years reported for Big Beef Creek summer chum were March 13, March 18, and March 27, respectively (Tynan 1997). The 10 % to 90 % emergence range observed across years was February 7 through April 14. Strait of Juan de Fuca summer chum generally emerge later than Hood Canal summers due to colder stream incubation temperatures. Estimated, average 10%, 50%, and 90% emergence dates for Strait of Juan de Fuca summer chum are March 6, April 4, and April 26, respectively. The 10% to 90% emergence range estimated across years for Strait chum is February 15 through May 26 (Tynan 1997).

Fry emerge with darkness, and immediately commence migration downstream to estuarine areas (Bakkala 1970, Koski 1975, Schreiner 1977, Koski 1981, Salo 1991), with total brood year migration from freshwater ending within 30 days for smaller streams and rivers (Salo 1991). Emerging chum fry have been shown to become very active with darkness (Hoar 1951), preferring the swiftest areas of downstream flow and exhibiting strong negative rheotaxis, often swimming more rapidly than the current (Hoar 1951, Neave 1955).

(5) Estuarine and Marine Life History

Upon arrival in the estuary, chum salmon fry inhabit nearshore areas (Schreiner 1977, Bax 1982, Bax 1983, Whitmus 1985). Chum fry have a preferred depth of between 1.5-5.0 meters at this time (Allen 1974) and are thought to be concentrated in the top few meters of the water column both day and night (Bax 1983b). In Puget Sound, chum fry have been observed through annual estuarine area fry surveys to reside for their first few weeks in the top 2-3 centimeters of surface waters and extremely close to the shoreline (Ron Egan, WDFW, Olympia, WA, pers. comm. cited in NMFS 2000). Iwata (1982) reported that, in Japan, chum orientated in stratified surface waters (20-100 cm depth) upon arrival in the estuary, showing a very strong preference for lower salinity water (10 to 14 ppt) found above the freshwater/saltwater interface, perhaps as a seawater acclimation mechanism. This nearshore and surface behavior could also be linked to survival, as small size exposes youngest fry to heavy predation. Onshore location may protect the fry from larger fish (Gerke and Kaczynski 1972, Schreiner 1977) and schooling behavior may be an adaptation to predator avoidance (Feller 1974).

Chum fry arriving in the Hood Canal estuary are initially widely dispersed (Bax 1982), but form loose aggregations oriented to the shoreline within a few days (Schreiner 1977, Bax 1983, Whitmus, 1985). These aggregations occur in daylight hours only, and tend to break up after dark (Feller 1974), regrouping nearshore at dawn the following morning (Schreiner 1977, Bax 1983). Bax *et al.* (1978) reported that chum fry at this initial stage of out-migration use areas predominately close to shore. "Early run" chum fry in Hood Canal (defined as chum juveniles migrating during February and March) usually occupy sublittoral seagrass beds with residence time of about one week (Wissmar and Simenstad 1980). Schreiner (1977) reported that Hood Canal chum maintained a nearshore distribution until they reached a size of 45-50 mm, at which time they moved to deeper off-shore areas.

Chum fry captured in nearshore environments during out-migration in upper Hood Canal were found to prey predominantly on epibenthic organisms, mainly harpacticoid copepods and gammarid amphipods (Bax *et al.* 1978, Simenstad *et al.* 1980). Diet changed to predominantly pelagic organisms in early May for fry migrating in off-shore areas. Dabob Bay chum fry were reported to feed continuously (day and night) in using nearshore areas as a source of food (Feller 1974). Feller (1974) and Gerke and Kaczynski (1972) documented initial preference (and predominance in the diet) of epibenthic prey by chum fry in Dabob Bay, followed by a gradual switch to pelagic prey as time progressed. Several researchers have documented a reliance on drift insects by migrating chum fry in British Columbia (Mason 1974) and in Dabob Bay, Hood Canal (Gerke and Kaczynski 1972). Hatchery-released chum fry in southern Hood Canal were found initially to prey almost exclusively on terrestrial insects, likely made available as drift from the Skokomish River (Whitmus 1985). Faster-migrating fry that had moved further north of the Skokomish delta were found to feed entirely on neritic and epibenthic organisms. Simenstad *et al.* (1980) showed a gradual decrease in the epibenthic fraction of stomach contents as the chum increased in size. Migration off-shore could result from opportunistic movement of fry to take advantage of larger, more prevalent prey organisms in the neritic environment (Bax 1983).

Summer chum entering the estuary are thought to immediately commence migration seaward, migrating at a rate of 7 - 14 km/day (Tynan 1997). Rapid seaward movement may reflect either "active" migration in response to low food availability or predator avoidance, or "passive" migration, brought on by strong, prevailing south/southwest weather systems that accelerates surface flows, and migrating fry present during the late winter-early spring time period, northward (Bax *et al.* 1978, Simenstad *et al.* 1980, Bax 1982, Bax 1983). Assuming a migration speed of 7 km/day, the southernmost out-migrating fry population in Hood Canal would exit the Canal 14 days after entering seawater, with 90 % of the annual population exiting by April 28 each year, on average. Applying the same migration speed, summer chum fry originating in Strait of Juan de Fuca streams would exit the Discovery Bay region 13 days after entering seawater, or by June 8 each year (90 % completion).

After two to four years of rearing in the northeast Pacific Ocean, maturing Puget Sound-origin chum salmon follow a southerly migration path parallel to the coastlines of southeast Alaska and British Columbia (Neave *et al.* 1976, Salo 1991, Myers 1993). The precise timing of this migration from Gulf of Alaska waters for Hood Canal summer chum is unknown. Genetic stock identification data collected from Canadian Strait of Juan de Fuca commercial net fisheries (LeClair 1995, 1996), Canadian fishery recoveries in 1995 of coded wire tagged Big Quilcene summers (PSMFC data, August 14, 1996) and a single recovery in Big Beef Creek of a summer chum tagged in a southeast Alaska ocean fishery study (Koski 1975), suggest that the southerly ocean migration down the Pacific Northwest coast and into the Strait of Juan de Fuca likely commences in mid-July, and continues through at least early September. Migrational timing of Strait of Juan de Fuca summer chum into Washington marine waters appears earlier than arrival timing observed for Hood Canal summer chum. The stocks in this region enter the terminal area (the Strait) from the first week of July through September (WDFW and WWTIT 1994). GSI data collected from Canadian net fisheries at the entrance to the Strait suggests that Hood Canal and Strait of Juan de Fuca summer chum are present through August and into early September (LeClair 1995, 1996).

Summer chum mature primarily at 3 and 4 years of age with low numbers returning at age 5 (there are rare observations of age 2- and 6-year fish). They enter the Hood Canal terminal area from early August through the end of September (WDFW and WWTIT 1994). Entry pattern data for Quilcene Bay provided by Lampsakis (1994) suggest that summer chum enter extreme terminal marine areas adjacent to natal streams from the third week in August, through the first week in October, with a central 80% run timing of August 30 through September 28, and a peak on September 16.

Comparison of extreme terminal area entry timing in Quilcene Bay with spawning ground timing estimates developed from Big Quilcene River data, suggests that summer chum may mill in front of their stream of origin for up to ten to twelve days before entering freshwater (with shorter milling times later in the run). Thus it is assumed that summer chum observed on spawning grounds entered the river five days earlier, based on a ten day average survey life. This behavior is likely related to the amount of time required for the chum to complete maturation and to acclimate to freshwater, but is also affected by available stream flows.

(6) Adult Freshwater Migration and Spawning

Spawning ground entry timing in Hood Canal ranges from late August through mid-October. Lampsakis (1994) reported a central 80 % spawning ground timing in the Big Quilcene River of September 11 through October 14, with a peak on or about September 28, based on 22 years of spawning ground survey data. Strait of Juan de Fuca summer chum begin spawning during the first week of September, reaching completion in mid-October (WDFW and WWTIT 1994). Time density analysis of Snow, Salmon and Jimmycomelately creek spawner survey data for the lower portions of the drainages indicates a central 80 % spawning ground timing of September 16 through October 20, with an average peak on October 2 (Lampsakis 1994).

Hood Canal summer chum typically spawn soon after entering freshwater in the lowest reaches of natal streams (Koski 1975, Schroder 1977, Johnson *et al.* 1997). This characteristic may reflect an adaptation to low flows present during their late summer/early fall spawning ground migration timing, which confine spawning to areas with sufficient water volume. Spawning in lower river reaches during low flows, however, confines incubating eggs to center channel areas, exposing the eggs to increased risk of egg pocket scouring during freshets. Koski (1975) noted that Big Beef Creek summer chum spawning took place predominantly in the lower 0.8 km of stream. Cederholm (1972) reported that 100 % of the summer chum run to Big Beef Creek in 1966 and 1967 spawned in the lower 0.6 km of the creek. WDFW documentation of summer chum spawning in the Big Quilcene River indicates that 90% of spawning occurs in the lower mile of the 2.2 miles of river accessible to salmonids. Summer chum spawn in the lower mile of Salmon Creek and in the lower one-half mile of Snow and Jimmycomelately creeks (WDFW and WWTIT 1994). As with Hood Canal summer chum, low summer-time flows likely have acted to confine summer chum spawning in this region to the lowest reaches of each production stream.

(7) Population Trends

Of the sixteen populations of summer chum identified in this ESU, seven are considered to be "functionally extinct" (Skokomish, Finch Cr., Anderson Cr., Dewatto, Tahuya, Big Beef Cr., and Chimacum). The remaining nine populations are well distributed throughout the ESU except for the eastern side of Hood Canal; those populations were among the least productive in the ESU (WDFW and PNPTT 2000).

This ESU has two geographically distinct regions: the Strait of Juan de Fuca (SJF) and Hood Canal (HC). Although the populations all share similar life history traits, the summer chum populations in the two regions are affected by different environmental and harvest impacts and display varying survival patterns and stock status trends.

In the Hood Canal region, summer chum are still found in the Dosewallips, Duckabush, Hamma Hamma, Lilliwaup, Big and Little Quilcene, and Union Rivers. A few chum have been observed in other systems during the summer chum migration period, but these observations are sporadic and are thought to be strays from other areas. Although abundance was high in the late 1970's, abundance for most Hood Canal summer chum populations declined rapidly beginning in 1979, and has remained at depressed levels (Table 1). The terminal run size for the Hood Canal summer chum stocks averaged 28,971 during the 1974-1978 period, declining to an average of 4,132 during 1979-1993. Abundance during the 1995-1998 period has improved, averaging 10,844. However, much of the increase in abundance can be attributed to a supplementation program for the Big/Little Quilcene River summer chum stock begun in 1992. Escapements in the Union have been stable or increasing in relation to historical levels. Escapements to the Dosewallips and Duckabush rivers have been generally above threshold levels of concern, but are highly variable. Escapements in the Hamma Hamma and particularly the Lilliwaup have been below threshold escapement levels that represent an increased risk to the population too often in recent years (Table 1).

Supplementation programs were instituted in 1992 for the Big/Little Quilcene, the Hamma Hamma and Lilliwaup stocks due to the assessment of high risk of extinction for these stocks (WDFW and PNPTT 2000). The Quilcene program has been quite successful at increasing the number of returning adults. The Hamma Hamma and Lilliwaup programs have been hampered by an inability to collect sufficient broodstock. A re-introduction program was also started in Big Beef Creek using the Quilcene stock. It is too early to assess the success of that program. Other re-introduction programs may be initiated in the future, but will depend on the development of additional broodstock sources so as not to become dependent on Quilcene as the sole donor stock.

In the Strait of Juan de Fuca, summer chum stocks are found in Snow, Salmon, and Jimmycomelately Creeks and the Dungeness River. (The Snow and Salmon are treated as a single stock complex.) The terminal abundance of summer chum in the Strait of Juan de Fuca region began to decline in 1989, a decade after the decline observed for summer chum in Hood Canal. Terminal abundance declined from an average of 1,923 for the 1974-1988 period to a average of 477 during 1989-1994 period. During the most recent period (1995-1998) the average for the region has increased to 1,039, however, much of the increase may be due to the supplementation program in the Snow/Salmon system that was initiated in 1992. Escapements in Jimmycomelately have continued to be poor, i.e., less than 100 spawners in the last three years. There are no systematic surveys for summer chum in the Dungeness. However, their presence is routinely noted in surveys for other species. The status of the summer chum population in the Dungeness is therefore unknown.

An assessment of the habitat in the Strait of Juan de Fuca chum watersheds concluded that these were among the most degraded watersheds in the ESU (WDFW and PNPTT 2000). Winter peak and summer low flows, and sediment aggradation are considered problems in the Dungeness, Jimmycomelately and Snow Creeks. Improvement in habitat conditions will be essential for successful recovery of summer chum in this region of the ESU.

b. Puget Sound/Strait of Georgia Chum ESU - Unlisted Species

The Puget Sound/Strait of Georgia chum salmon ESU (fall chum) is comprised of fall spawning populations that occur within the action area and includes all naturally spawned populations of chum salmon from Puget Sound and the Strait of Juan de Fuca up to and including the Elwha River. Fall chum are genetically distinct from Hood Canal summer chum ESU described above. Genetic differences between summer chum and all other chum stocks in the U.S. and British Columbia are a result of long-standing reproductive isolation of the Hood Canal and Strait of Juan de Fuca summer chum populations (Tynan 1992). This isolation has been afforded by a significantly different migration and escapement timing, and geographic separation from other chum stocks in the Pacific Northwest (Tynan 1992, Johnson *et al.* 1997). Hood Canal fall chum stocks were distinguished by the co-managers (State and Treaty Tribes) through geographic separation (primarily by drainage) and differences in run timing (WDF *et al.* 1993, Appendix 1).

WDF *et al.* (1993) characterized three fall and late-fall spawning chum stocks that occur in the Action Area: 1) Lower Skokomish, 2) Upper Skokomish (late), and 3) West Hood Canal. At that time Lower Skokomish and West Hood Canal stocks were considered healthy; status of the Upper Skokomish late fall stock was unknown. A significant consideration of the status of chum salmon in Hood Canal is the continued influence of hatchery production on wild or naturally-spawned stocks. Both the Lower Skokomish and West Hood Canal stocks were considered to be of "mixed" origin (from both wild and hatchery sources). Tynan (1997) provides a detailed examination of chum hatchery production in the Hood Canal region and notes that the effects of hatchery production on wild summer or fall chum has been largely unstudied.

General descriptive information about fall chum life history and habitat requirements is included with information provided for Hood Canal summer chum, above. However, run timing of "fall" chum is shifted later in the year and slightly overlapping summer chum. River entry of adults and spawning is quite variable in fall chum, ranging from "early fall-run" chum reported to spawn between mid-November (based on West Hood Canal chum) to "late fall-run" fish that spawn from mid-December to late January. These and other aspects of fall chum life history are detailed in Johnson *et al.* (1997) in their status review of chum salmon in Washington, Oregon and California. Based on this review, additional information and an extensive public involvement process, the NMFS determined that listing was not warranted for this ESU (63 Fed. Reg. 11744; March 10, 1998).

3. <u>Steelhead Trout</u>

a. Puget Sound Steelhead ESU - Unlisted Species

This coastal steelhead ESU occupies river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. Included are river basins as far west as the Elwha River and as far north as the Nooksack River. No recent genetic comparisons have been made of steelhead populations from Washington and British Columbia, but samples from the Nooksack River differ from other Puget Sound populations, and this may reflect a genetic transition zone or discontinuity in northern Puget Sound. In life history traits, there appears to be a sharp transition between steelhead populations from Washington, which smolt primarily at age 2, and those in British Columbia, which most commonly smolt at age 3. This pattern holds for comparisons across the Strait of Juan de Fuca as well as for comparisons of Puget Sound and Strait of Georgia populations. At the present time, therefore, evidence suggests that the northern boundary for this ESU coincides approximately with the U.S.-Canada border.

Recent genetic data provided by WDFW show that samples from the Puget Sound area generally form a coherent group, distinct from populations elsewhere in Washington. There is also evidence for some genetic differentiation between populations from northern and southern Puget Sound, but the NMFS Biological Review Team (BRT) did not consider that ecological or life history differences were sufficient to warrant subdividing this ESU. Chromosomal studies show that steelhead from the Puget Sound area have a distinctive karyotype not found in other regions.

Most of the life history information for this ESU is from winter-run fish. Apart from the difference with Canadian populations noted above, life history attributes of steelhead within this ESU (migration and spawn timing, smolt age, ocean age, and total age at first spawning) appear to be similar to those of other west coast steelhead. Ocean age for Puget Sound summer steelhead varies among populations; for example, summer steelhead in Deer Creek (North Fork Stillaguamish River Basin) are predominately age-1-ocean, while those in the Tolt River (Snoqualmie River Basin) are most commonly age-3-ocean (WDF *et al.* 1993).

This ESU is primarily composed of winter steelhead but includes several stocks of summer steelhead, usually in subbasins of large river systems and above seasonal hydrologic barriers. Nonanadromous O. mykiss co-occur with the anadromous form in the Puget Sound region; however, the relationship between these forms in this geographic area is unclear.

b. SW Washington Steelhead ESU - Unlisted Species

This coastal steelhead ESU occupies the tributaries to Grays Harbor, Willapa Bay, and the Columbia River below the Cowlitz River in Washington and below the Willamette River in Oregon. The SW Washington ESU is delineated primarily by genetics and habitat features. Recent genetic data (Leider *et al.* 1995) show consistent differences between steelhead populations from the southwest Washington coast and those from coastal areas to the north, as well as those from Columbia River drainages east of the Cowlitz River. Existing data, however, do not clearly define the genetic relationship between steelhead from the southwest Washington coast and those from Columbia River tributaries below the Cowlitz River.

The geographic location of this ESU corresponds to the Chehalis and Columbi River glacial refugia during the Wisconsin Glaciation. Although there are morphological differences between populations of fish species common to the Chehalis and Columbia Rivers, both share a common Columbia River ichthyofauna (McPhail and Lindsey 1986). The two river basins are physically separated a present, but transport of sediments of Columbia River origin to both Grays Harbor and Willapa Bay (Landry and Hickey 1989) provides an ecological link. Furthermore, Monaco *et al.* (1992) found similarities in the estuarine ichthyofauna of Grays Harbor, Willapa Bay, and the Columbia River.

This ESU is primarily composed of winter run steelhead but includes summer steelhead in the Humptulips and Chehalis River Basins. Nonanadromous *O. mykiss* co-occur with the anadromous form in southwest Washington rivers; however, the relationship between these forms in this geographic area is unclear. Life history attributes for steelhead within this ESU appear to be similar to those of other west coast steelhead.

4. Pink Salmon - Unlisted Species

The pink salmon that occur within the Plan Area are part of the odd-year pink salmon populations in Puget Sound and the Strait of Juan de Fuca, Washington, that extend as far west as the Dungeness River (or the Elwha River, if that population is not already extinct) and in southern British Columbia (including the Fraser River and eastern Vancouver Island) as far north as Johnstone Strait. No even-year pink salmon populations occur within the action area, or are thought to have been historically present.

Odd-year pink salmon have rarely been observed holding in portions of the mainstem and South Fork of the Skokomish River in the northern portion of the Plan Area (P.Peterson, Simpson Timber Company, Personal Communication, July 2000). Skokomish River pink salmon were identified by Nehlsen *et al.* (1991) as a stock at risk of extinction. In 1993, WDF *et al.* elected to disclude Skokomish River pink salmon from their review of salmon stocks, citing reasons that this stock is historically extinct or not (then) currently verifiable. Hard *et al.* (1996) reviewed the life history and population trends of pink salmon to complete a status review of populations in Washington and Oregon. A thorough review of pink salmon life history and distribution is provided in Groot and Margolis (1991). The NMFS determined that listing was not warranted for pink salmon (Fed. Reg. 64 51928, March 25, 1995).

5. Coho Salmon - Unlisted Species

The Puget Sound coho ESU occurs within the action area and includes all naturally spawned populations of coho salmon from drainages of Puget Sound and Hood Canal, the eastern Olympic Peninsula (east of Salt Creek), and the Strait of Georgia from the eastern side of Vancouver Island and the British Columbia mainland (north to and including the Campbell and Powell Rivers), excluding the upper Fraser River above Hope. Weitkamp *et al.* (1995) completed a status review of coho salmon in Washington, Oregon and California. Based on this review, additional information and an extensive public involvement process, the NMFS determined that listing was not warranted for this ESU (60 Fed. Reg. 30811; July 25, 1995).

The Lower Columbia/ Southwest Washington coho ESU encompasses Chehalis River tributaries in the Plan Area. Biological information and historical population trends of coho salmon may also be found in Weitkamp *et al.* (1995). Both coho ESUs are considered at some risk of survival through some or a part of their range but are not sufficiently at risk to warrant protection as threatened species. Both ESUs remain designated candidates for listing (see Table 1).

C. Critical Habitat

Critical habitat refers to the specific areas, both occupied and unoccupied, that contain those physical or biological features that are essential to the conservation of the species and which require special management considerations or protection (see ESA §3(5)(A)). Generally, critical habitat for anadromous salmonids is designated within specific geographies and includes those streams and riparian areas comprising the historic and/or longstanding distribution of the species.

Critical habitat for Puget Sound chinook and Hood Canal summer chum salmon has been designated (see Table 1). The proposed action, issuance of an ITP to Simpson Timber, will likely affect critical habitats within and potentially downstream of the Plan Area. The mechanisms through which critical habitats may be affected are primarily through commercial forestry activities that affect ecological processes that maintain and create habitats for salmonids. These dominant mechanisms include: 1) riparian forest management that decreases large wood debris recruitment, shade, litter fall, and nutrients delivered to streams, 2) increased delivery of coarse and fine sediments to streams from mass-wasting of hillslopes and roads, and the erosion and transport of sediments from road surfaces and ditchlines, 3) increased peak stream flows that come with loss of vegetation and extending the drainage network with road ditchlines, and, 4) increases in water temperature, both short- and long-term, that come about through complex interactions of stream canopy (shade), widening of stream channels with increased sediment transport, and alterations of groundwater hydrology and hyporheic zones. The general potential effect of these mechanisms is to simplify or redistribute habitats for salmonids, as discussed in Sections V. and VI. of this Opinion. Appendix G of the HCP (STC July 2000) provides a detailed assessment of interactions of shade and sediment on water quality. Conservation measures to avoid, minimize and mitigate effects on designated critical habitats and habitat for all salmonids is described in Section V. B. of this Opinion and Section 7 of the HCP (STC July 2000).

Habitat requirements for all anadromous salmonids include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space and safe passage conditions. Good summaries of the environmental parameters and freshwater factors that comprise critical habitats for Puget Sound chinook and Hood Canal summer chum salmon, and other anadromous salmonids, can be found in: Barnhart 1986; Bjornn and Reiser 1991; Botkin *et al.* 1995; Brown and Moyle 1991; CACSST 1988; Groot and Margolis 1991; NRC 1996; NMFS status reviews (see Table 1 in this Opinion); Higgins *et al.* 1992; McEwan and Jackson 1996; Meehan 1991; Nehlsen *et al.* 1991; Pauley *et al.* 1986; Stouder *et al.* 1997; Spence *et al.* 1996; Tynan 1997; and the State of Washington 1999.

Defining specific river reaches that are critical for endangered or threatened anadromous fishes is difficult because of their low abundance and because of our limited understanding of the species current and historical freshwater distributions (63 Fed. Reg. 11510; March 9, 1998). Based on consideration of the best available information regarding the species current distribution, NMFS believes that the preferred approach to identifying the freshwater and estuarine portion of critical habitat is to designate all areas (and their adjacent riparian zones) accessible to the species within the range of each ESU (*Ibid.*).

The NMFS believes that adopting a more inclusive, watershed-based description of critical habitat is appropriate because it (1) recognizes the species' use of diverse habitats and underscores the need to account for all of the habitat types supporting the species' freshwater and estuarine life stages, from small headwater streams to migration corridors and estuarine rearing areas; (2) takes into account the natural variability in habitat use (e.g., some streams may have fish present only in years with plentiful rainfall) that makes precise mapping difficult; and (3) reinforces the important linkage between aquatic areas and adjacent riparian/upslope areas (*Ibid.*).

IV. ENVIRONMENTAL BASELINE

The environmental baseline for the anadromous salmonid species that inhabit the area covered by the HCP includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR §402.02). Populations of anadromous salmonids are at risk or already extinct in many river basins in Washington, leading to the numerous ESA listings and proposed listings for anadromous fish. These populations have declined due to a variety of human activities and natural events including hydropower development, overharvest, land management activities, artificial propagation, disease, predation, competition from introduced species, and climatic variation leading to temporarily unfavorable ocean conditions (see for example Busby *et al.* 1996, FEMAT 1993, Meyers *et al.* 1998, NRC 1996, Spence et al., 1996, State of Washington 1999).

Access to a substantial portion of historical habitat for some anadromous species in the action area has been precluded or limited locally and cumulatively by various dams. In the northern part of the action area migratory fishes are blocked at River Mile 8.9 of the North Fork of the Skokomish River. In the south they are blocked at River Mile 48 of the Wynoochee River. Generally, there are also local habitat problems related to irrigation diversions, degraded riparian and instream habitat from urbanization and transportation development, land conversion to crops and orchards, livestock grazing, and timber harvest (see above).

The listed anadromous salmonid species analyzed herein are subjects of recent listing decisions by the NMFS referenced in Table 1. Consequently, few project-level consultations have been completed within the overall Plan Area that have specific bearing on this action. At the landscape level, however, the effects of current forest and watershed management activities by the USFS is a consideration that has been addressed by the NMFS through participation in the development of, and formal consultation on Federal actions under the Northwest Forest Plan. Future federal actions that bring new lands under USFS management, change land allocations or management designations, or impact habitats for listed anadromous fishes will be addressed in separate formal consultations. Accordingly, this Biological Opinion addresses the environmental baseline reflecting the past and present impacts of previous and ongoing Federal (that have already undergone formal consultation), State, and private activities in the HCP area, for which there is adequate information. Sections 3.1 and 3.2 of the HCP (STC July 2000) and the Services' FEIS (USFWS and NMFS July 2000) provide comprehensive descriptions of the baseline conditions in the action area.

An important consideration in baseline conditions are lands managed by the Washington Department of Natural Resources (WDNR) under an existing HCP (WDNR 1997) within 10 miles of the Plan Area. The WDNR Plan and associated Implementing Agreement and Incidental Take Permit cover forestry and other activities that may affect listed anadromous salmonids and their habitats. The WDNR HCP utilizes a suite of conservation measures that are expected to minimize take of anadromous fishes. The NMFS has consulted on this HCP and issued a Biological Opinion (NMFS 1999) and found that activities covered by the Plan, in accord with the HCP, associated documents, and as adapted, would not jeopardize the continued existence of then-proposed or listed species. Multiple ESUs within the WDNR Plan Area have now been listed under the ESA and the NMFS has issued an Incidental Take Permit to the WDNR for six salmon ESUs, including Puget Sound chinook (See June 14, 1999 Memorandum from S.W. Landino to W. Stelle, Jr.; Biological Opinion and Section 10 Findings Document for Washington Department of Natural Resources Habitat Conservation Plan Incidental Take Permit 1168; on file at the NMFS, Washington State Habitat Branch offices, Lacey, WA). However, that action, Permit issuance, will not change the commitments and conservation measures described in detail in the WDNR HCP (1997).

Non-Federal forest lands within and adjacent to the Plan Area come under the regulation of Washington Forest Practice Rules. These Rules have recently undergone revisions through "emergency" rules adopted by the Washington Forest Practices Board to protect salmon and bull trout, including Puget Sound chinook and Hood Canal summer chum salmon. This Salmonid Emergency Rule immediately increased riparian conservation measures along fish-bearing streams and limits sediment delivering activities, among many other facets. Most recently, the State of Washington, Federal Agencies, County governments, tribal governments reached agreement on a comprehensive set of conservation measures upon which to revise Washington Forest Practice Rules (the "Forests and Fish Report" (FFR), available from the Washington Department of Natural Resources, Olympia, WA). This Report was presented to Governor and Legislature of Washington State in April 1999 and resulted in approval of a bill (ESHB 2091) authorizing the Washington Board of Forestry to development emergency and final rules to protect anadromous fishes on nonfederal forestlands in the State. These new protections are described by the Governor's Salmon Recovery Office (State of Washington 1999). While it will take some time for the benefits of new forest practices to accrue, the effects will complement watershed management and overall function of riparian and instream habitats to the extent that these new forest practices will apply within and adjacent to the Plan Area.

A. Limiting Factors in the Action Area

Factors limiting production of anadromous salmonids have been analyzed in a series of watershed analyses covering various portions of the Action Area, including: 1) the South Fork Skokomish River (USDA 1995), 2) the Upper Wynoochee River (USDA 1996), and 3) the West Fork of the Satsop River (Weyerhaeuser and Simpson 1995). The watershed analysis teams (Federal and State resource agencies, tribes, landowners, and others with pertinent experience) ensured that all appropriate methods or approaches to limiting factors were considered, that the assumptions required in evaluating the significance of the limiting factors on each species were widely accepted and that all experience and data were evaluated from a wide perspective. The watershed analyses cited above cover approximately 60 % of the Plan Area and present a listing of the factors that potentially affect fish populations across all drainages. Analysis of these factors provides the basis for evaluation of the factors thought to be critical to the fish populations in the Plan Area. Briefly, these analyses find that the primary factors contributing to the decline of anadromous salmonid stocks in Action Area include:

1) Degradation and loss of spawning and rearing habitat resulting from many activities including agriculture, timber harvesting, road construction, urban development, water withdrawals and diversions, and dams;

2) Over-exploitation in marine and in-river fisheries;

3) Genetic and competitive survival effects from hatchery outplantings and introgression,

4) Migratory impediments such as dams and water diversions.

Although numerous factors limit each of the species of concern to a greater or lesser degree, the dominant historical and contemporary impacts on habitats in the Action Area are forestry and roads (both forest and public), dam operations on the Wynoochee River (mile 48) and the North Fork Skokomish River (mile 8.3) . All of the mentioned risk factors likely affect the quantity, quality, or distribution of habitats in specific locations, but the multiple action of these factors through complex mechanisms makes it difficult or impossible to distinguish cause and effect attributable to each. The relative benefits and impacts of Simpson Timber's HCP on fish stocks of concern is also analyzed in the final HCP (STC July 2000).

B. Summary of Species' Status

1. Chinook Salmon (Puget Sound ESU)

This ESU is inclusive of all Hood Canal and Puget Sound rivers and independent tributaries, including some in the eastern Strait of Juan de Fuca. Of streams within the Plan Area, the Skokomish River has always been the largest contributor and continues in that role today, although most of the production from the Skokomish is now of hatchery origin. The smaller tributary streams of Totten and Skookum Inlets and Oakland Bay historically were never more than a very small percentage of the overall ESU production and today, after decades of hatchery management in South Puget Sound and resultant poor wild escapements, can only be described as a minor remnant. The role of Plan Area streams in the recovery of this ESU must be considered a minor one based on the impacts of previous management and the relatively small production potential relative to the entire ESU. Locally, however, Plan Area streams represent dispersed production within the ESU and may be culturally valued for Tribal fishing. No special characteristics of runs in this ESU are documented for Plan Area streams and production is not remarkable from any other biological perspective.

2. Chum Salmon (Hood Canal Summer Run ESU)

The Hood Canal summer chum ESU is comprised of many small-population segments from the rivers and independent tributaries of Hood Canal. Production of summer chum occurs in the lower ends of streams in the ESU because the fish arrive on relatively low flows in the early fall. Most of the production of summer chum in the South Fork Skokomish River is expected to occur downstream of the Plan Area. Plan Area activities have been conditioned to minimize downstream sediment effects. The Plan Area channel network will support recovery of this ESU principally through the production generated from the mainstem of the South Fork Skokomish River and any of its lower tributaries that may provide suitable habitat. This contribution will be roughly proportional to the occurrence of the habitat distribution within the ESU and is otherwise unremarkable.

3. Coho Salmon (Puget Sound / Straight of Georgia ESU)

Plan Area streams represent a very small contribution for the conservation of this ESU, however locally they are capable of providing a dispersed production component. Harvest and hatchery management in the past has led to relatively poor wild coho returns to the independent tributaries that constitute the principal Plan Area production opportunity. However, habitat in these low gradient tributaries appears to be capable of producing coho in good numbers provided the escapement is satisfactory. No remarkable stock characteristics have been identified for runs in the Plan Area and it is unlikely that the aquatic habitat potential is any greater than its occurrence in the overall habitat base for the ESU.

4. Coho Salmon (Lower Columbia River / Southwest Washington ESU)

The Plan Area can contribute significantly but not uniformly to conservation of this coho ESU. The West and Middle Fork Satsop Rivers and the Canyon River do not have a significant tributary network within the Plan Area for the production of coho salmon and their mainstems are not particularly conducive because of relatively severe confinement within inner gorges of SIG LTU. The Wynoochee River and several of its larger tributaries and the East Fork of the Satsop River system including the Stillwater branch are the primary coho production areas in the Plan Area for this ESU. These streams are as efficient as any at producing coho in the region and can form the core of a coho strong hold in the southern Olympics. Even though there has been significant hatchery intervention in the ESU in the past, the Satsop River maintains a relatively large and late running stock that is somewhat unique in an otherwise homogeneous group of coastal coho.

5. Chinook salmon (Pacific Coast ESU)

Mainstem rivers and their larger tributaries support spawning by chinook salmon but there is nothing out of the ordinary about individuals occupying the Plan Area. The Plan Area will contribute to the regional conservation of this species proportionate to the habitat available to them. Nothing unique or remarkable exists about them with perhaps the exception of spring chinook on the Wynoochee and the South Fork Skokomish Rivers. These two runs may have been relatively small historically and have been all but extirpated today. The dam has affected the run in the Wynoochee and the run in the south Fork Skokomish began declining in the late 1950's from unknown causes. The Plan Area potentially could support relatively unique runs in these two areas when the limiting factors that have been responsible for their decline are eliminated.

6. Chum salmon (Pacific Coast ESU)

The East Fork Satsop River and its tributaries could make a significant contribution to the coastal chum ESU. Productive side-channel, tributary and mainstem habitats within the Plan Area are especially favorable. However, other factors such as run timing and body size are not remarkable and contribute nothing out of the ordinary to the ESU.

7. Pink salmon (Odd year ESU)

Pink salmon were never widespread in the Plan Area and it is unlikely that they will ever be a common species again. Populations in the Skokomish basin were apparently fairly significant at one time but have been depressed since the 1950's. Regional conservation will be primarily supported by tributaries of Hood Canal and Puget Sound substantially to the north of the Plan Area.

8. Steelhead trout (Washington Coast ESU)

Steelhead trout are supported by mainstem rivers and the larger tributaries of many Plan Area streams. The West Fork Satsop River has a relatively large bodied and late running wild run that represents a reasonably different and important local stock. Aside from that run, Plan Area streams and stocks are not noteworthy or remarkable.

9. Steelhead trout (Puget Sound ESU)

Nothing unique or remarkable about the fish or the habitat exists for steelhead in this ESU in the Plan Area. The contribution of Plan Area streams to steelhead production in this ESU may only be especially distinguished by the South Fork Skokomish River, which has excellent habitat above the canyon, and in the North Fork above its confluence with the South Fork. Production has been reasonably strong in these areas in the recent past and is expected to continue under HCP management.

V. ELEMENTS OF THE HABITAT CONSERVATION PLAN

A. Overall Goal of the HCP

The overall goal of the HCP is to maintain and develop intact, ecologically connected, and naturally functioning aquatic and riparian ecosystems that may be affected by Simpson Timber forest management activities in the Plan Area, while allowing the company to operate in an economically certain and rewarding manner. Simpson's conservation program emphasizes the protection and development of riparian forests as the primary strategy for satisfying requirements of Section 10 of the ESA. Complementing the functional approach to riparian forest and stream habitat conservation are measures that address specific wildlife species. The management prescriptions in this HCP are expected to conserve riparian forests, improve water quality, prevent management related hillslope instability, address hydrologic maturity of small sub-basins, maintain and generate late-seral riparian forests and snags, and control human disturbance to wildlife species. The suite of management prescriptions described in Section 5 of the HCP is expected to benefit a wide range of species that inhabit the Plan Area including others for which no ESA coverage is sought.

Simpson proposes that implementation of the HCP should yield the following benefits:

- The aquatic resource base, from a scientific perspective, is placed on an improving trend line as a result of Simpson's conservation practices.
- Simpson's activities will yield a net benefit to a wide range of listed and sensitive fish and other wildlife species.
- With greater certainty, Simpson will be able to operate in an economically rewarding manner. Simpson will be able to continue to harvest its timber on a long-term sustainable basis, which will yield positive results for the company and for the communities dependent upon Simpson for jobs and economic health.

B. Proposed Conservation Measures to Avoid, Minimize, and Mitigate Take.

A suite of measures are proposed in the HCP that collectively contribute to protection and restoration of the species and habitats addressed by this action. These measures were designed to control, avoid, or minimize impacts from commercial forest operations, to preserve habitat elements that are relatively undisturbed, and to passively or experimentally restore the quality and functionality of habitats that have been previously disturbed.

1. Timber Harvest Unit Size:

Timber harvest unit size would be restricted by current and future rules of the Washington State Forest Practices Act. Harvest units may be up to 240 acres in size, but are expected to average about 60 acres. Some management actions, such as clearcuts larger that 120 acres, would require a Class IV Special Permit, which requires analysis under the requirements of the Washington State Environmental Policy Act (SEPA). Through the SEPA process, the general public, local stakeholders, and the Services would have the opportunity to be involved, thus providing additional assurances of protections for public resources. For aquatic resources this limit should avoid creation of large areas of hydrologically immature forest.

2. Riparian Conservation

Riparian conservation in the Simpson HCP is initially explained by allocation of the approximately 22,191 acres of riverine riparian area that includes stream-associated wetlands (Table 2, below). This Riparian Conservation Reserve (RCR) is distributed along streams, wetlands, and unstable landforms near streams through geomorphic and functional classification of water bodies. A complete understanding of riparian conservation measures and their relationships at the landscape and stream reach levels is provided in sub-sections that follow on *Landscape Stratification*, *Channel Classification*, and *Riparian Conservation Strategies*. A comprehensive description of riparian conservation is provided in Section 6, Appendix B and mapped in Figure 5 of the HCP (STC July 2000).

Riparian conservation measures for streams are summarized from HCP Tables 26 and 27 (STC July 2000) below:

- For Type 1-3 Streams (DNR classification, perennial fishbearing), no harvest in the inner core of the channel migration zone and at least 70% of the outer zone. Riparian widths will vary depending on geomorphic stream classification and the following riparian strategies:
    - Canyon: 50-116 feet
    - Channel Migration: 83-215 feet
    - Break in slope: 33-99 feet (plus the area below the break in slope)
    - Inner Gorge: 99-132 feet
    - Reverse Break in slope: 66-99 feet
    - Temperature Sensitive: 50-83 feet
    - Alluvial Bedrock Transitional: 50-83 feet
    - Unstable Slope/ Intermittent flow: 3 acres of unharvested riparian area per 1,000 feet of channel
- Type 4 streams (perennial, non-fishbearing) are protected with 66 feet of continuous unharvested riparian area, each side.

- Type 5 streams (defined channels with intermittent flow) are prescribed 80 trees per 1,000 feet of channel in minimum patches of 0.5 acres.

- Along Type 5 streams (with adjacent unstable slopes that can deliver sediment to the channel) riparian protections are increased to 160 trees per 1,000 feet, continuous.

Table 2. Approximate acreage of riparian, wetland and unstable slope protection in the Simpson HCP.

Conservation Area Type	Acres
[illegible]	
Type 1, 2 and 3 [a] (fishbearing, including unstable slopes)	16,606
Type 4 and 5 [b] (non-fishbearing including unstable slopes)	3,013
Riverine channel bed	2,572
Subtotal	*22,191*
[illegible]	
Non-forested wetlands	6,059
Non-forested wetland buffer *with no harvest*	1,946
Non-forested wetland buffer *with potential thinning*	2,635
Forested wetlands (75 percent of those not connected to riparian areas)	2,793
Subtotal	*13,433*
[illegible]	
Unstable slopes	6,019
Total	41,643

a Riverine Riparian Conservation Area Assumptions:

DNR Stream Types 1, 2 and 3 are perennial fishbearing streams
DNR Stream Types 4 and 5 are non-fishbearing
Riparian protection would be based on conservation buffers defined in Appendix B of the HCP.

b Type 9 streams (unclassified according to the DNR Forest Practices Rules) would be classified before timber management occurs adjacent to those streams. For the purposes of this analysis, those streams were classified as either Type 3, 4 or 5 streams based on best available information using geographical information system (GIS) data bases .

a. Landscape Stratification

The conservation of riparian processes and their dominant control on aquatic habitats is fundamentally based on a stratified view of the landscape in the Plan Area. The influences of the geologic setting and associated physical processes on aquatic habitats are captured by stratifying the landscape into "lithotopo units" (LTUs) which are areas of similar lithology and topography (after the general concept of Montgomery 1977). This level of landscape stratification is described in Section 2.2 and mapped in Figure 3 of the HCP (STC July 2000).

The Plan Area has been divided into five LTUs:

- Alpine Glacial (AGL),
- Crescent Islands (CIS),
- Crescent Uplands (CUP),
- Recessional Outwash Plain (ROP), and
- Sedimentary Inner Gorges (SIG).

The location and characteristics of each LTU are described below. These LTUs represent a finer scale stratification of the regional landscape than has previously been proposed (see for example Omernik 1987), and divides the Plan Area into areas that share similar erosional and channel forming processes. This level of stratification is critical to understanding the productivity of the HCP area streams, their response to historical logging practices and natural disturbances, their habitat response over time, and their sensitivity to current logging operations.

(1) Alpine Glacial LTU

The Alpine Glacial LTU (8.5 percent of the Plan Area) is the land west of the divide between the West Fork Satsop River and Schafer Creek and north of Carter Creek, encompassing the Wynoochee River and its tributaries, exclusive of those segments that lie in the CUP. Glacial deposits of gravels, sands, silts, and clays native to the Olympic Mountains are prevalent in this unit. Some of these deposits are highly cemented, and where they occur in stream banks are resistant to erosion, often maintaining a vertical or an undercut slope. Sediment is delivered to channels in this unit through gradual bank erosion and shallow rapid landsliding of accumulated soils on steep side slopes where channels cut through terraces of the ancient Wynoochee River. Channels with connections to steeper headwaters in the CUP receive sediment and wood from catastrophic processes (mass wasting and debris torrents) common to that LTU. In stream segments whose banks are composed of resistant glacial till, recruitment of woody debris from on-site is principally through windthrow or shallow-rapid landslides rather than bank undercutting and channel migration.

(2) Crescent Islands

The Crescent Islands LTU (11.8 percent of the Plan Area) is the area directly to the south and west of Shelton encompassing the watersheds of Mill Creek above Lake Isabella, Kennedy and Skookum Creeks and parts of Goldsborough, Wildcat and Cloquallum Creeks. Principal

topographic features of this unit are the basalt "islands" around and between which flow low gradient, gravel rich stream systems. These islands were overridden by the continental ice sheets as evidenced by the glacial drift overlying their slopes. The thickness of these non-native deposits thins with increasing elevation. Recessional melt pathways were established through this area as the glacial meltwater flowed initially to the south, exiting through the Chehalis River and Grays Harbor. Significant deposits of unconsolidated sand and gravel characterize present day channel banks and lower terraces. The ample supply of foreign granitic gravels makes these low gradient channels excellent spawning habitat for chum salmon, and their low gradient pool riffle channel bed morphology makes them very productive for coho salmon. However, the unconsolidated character of their stream banks makes them susceptible to inputs of fine sediments through bank erosion. Large woody debris is recruited relatively quickly along moderate to large channels through bank undercutting and channel migration.

(3) Crescent Uplands LTU

The Crescent Uplands LTU (10.7 percent of the Plan Area) is an area of the southern Olympic foothills composed of massive basalt and breccia rock types. This unit runs across the northern tier of Simpson's ownership and also encompasses portions of the adjoining USFS lands. The headwaters of Bingham, Dry Bed, and Rabbit Creeks are in this unit, as are Vance Creek, the South Fork of the Skokomish River and its tributaries, the headwaters of the Middle and West Forks of the Satsop River, and parts of the upper Wynoochee River and its tributaries. The dominant sediment delivery processes in this unit are debris torrents and shallow rapid landslides. The CUP landscape is highly dissected, resulting in high drainage density and a high degree of connectivity between the logging road system and the channel network. Woody debris recruits to the channel mainly through catastrophic processes with some addition of individual trees or small groups from localized streamside slope failures. These catastrophic log recruitment processes, in combination with the highly confined channels, can result in large valley logjams. Runoff patterns tend to be rapid due to the shallow nature of soils and underlying bedrock. Much of this LTU lies at elevations that make the occurrence of rain on snow (ROS) events more likely.

(4) Recessional Outwash Plain LTU

The Recessional Outwash Plain LTU (44.9 percent of the Plan Area) encompasses the extensive area of low relief extending from Mason Lake, north and east of Shelton, to the area west of

Shelton, south of the CUP, and east of the SIG. This unit was formed by repeated advances of continental ice sheets and resultant recessional outwash during the Pleistocene period. Its soils are rich in sediments (stratified gravels, sands, silts and clays) foreign to the Olympic Peninsula. Channels flowing across this unit have flat slopes and abundant gravel deposits stored in the channel bed and banks. For streams originating on the ROP, sediment and wood are only delivered via localized bank undercutting as no channel connection to steep headwater areas exists. In some parts of this unit, infiltration of rain is affected by impermeable glacial tills and as a result stream stage may rise and fall quickly in response to winter storms in spite of their otherwise low energy regime. In more southerly areas and especially to the west and along the Olympic Mountain front, channels are prone to intermittency. Ground water sources maintain strong flow in other major tributaries of the ROP (e.g. Stillwater River, Bingham and Decker Creeks).

(5) Sedimentary Inner Gorges LTU

The Sedimentary Inner Gorges LTU (24.1 percent of the Plan Area) comprises the area to the west of the divide between Decker Creek and the Middle Fork of the Satsop River and the divide between the Schafer and the West Fork of the Satsop River and south of the CUP. This unit extends south into Satsop River tributaries (Cook Creek) and cuts west in the Carter Creek basin south of the contact with the Olympic glacial outwash. Marine siltstones, mudstones, and sandstone characterize the lithology of the SIG. Soils are deep and highly erodible and the channel network is deeply incised. The entrenched nature of the channel network is the dominant characteristic of streams in this unit. Significant sediment delivery processes in this unit include massive deep-seated landslides of many ages, inner gorge side slope failures, (especially in the mudstone and siltstone reaches of the channel network), and shallow rapid failures of the channel side slopes in the sandstone channel segments. A unique feature of the bedrock in this unit is the unusually high rate of weathering as a result of desiccation and exfoliation in the summer and calving of side slopes from freezing and thawing and fluvial erosion in the winter. Woody debris recruits to the channel network in this unit catastrophically through side slope failures in the inner gorges and deep-seated landslides. Single tree recruitment as a result of bank recession also is a significant contributor of wood to the channel system from lower floodplains and terraces where they occur within inner gorge settings. The deep soils and weathered bedrock of this unit retain water well resulting in many small perennial channels.

b. Stream Classification

The stream classification employed in the Simpson HCP departs from traditional systems in the Pacific Northwest where the primary purpose is to provide a management framework for rule-based limits on forest practices near streams. These systems all have some basis in physical science, but they have largely been driven by arbitrary distinctions such as the presence or absence of salmonid fishes. Consequently regulatory focus and management guidelines have been established based on site level attributes rather than watershed and reach level processes.

Recent work in this area has described entire channel networks from a process perspective (Montgomery and Buffington 1997). These new approaches have opened the way for the development of more sophisticated classification schemes that explicitly acknowledge the longitudinal and hillslope connections within channel networks in forested landscapes.

The Washington State Forest Practices Act has 6 stream types (1, 2, 3, 4, 5, and 9). Type 9 is the designation for non-typed stream segments. These stream segments often occur at the tip of the channel network and field verification usually determines them to be Type 4 or 5. Stream Types1-3 have fish, Types 4 and 5 do not. Simpson has identified approximately 1,398 miles of stream in the Plan Area, all assigned DNR stream type in Simpson's geographic information system (GIS). Stream types have been verified through the latest data available (Quinault Indian Nation and Simpson Timber Co. unpublished data). Miles of stream channel by HCP channel class, class character (size, confinement, substrate), and DNR stream type are presented in Table 3, below.

Table 3. Channel class, character, miles, and DNR stream types in the Simpson Plan Area.

			DNR Stream Type (miles)					
Channel Class	Class Character	Class Miles	1	2	3	4	5	9
AGL-Qa6	Lg, UC, PR	12.7	12.5	0.2	0.0	0.0	0.0	0.0
AGL-Qo1	Sm, HC, SP_f/SP	61 3	0.0	0.5	10.4	7.6	24.6	18.2
AGL-Qo2	Sm, MC-UC, PR_f	22.5	0.0	0.0	7.9	3.5	3.7	7.4
AGL-Qo3	Sm, HC, PR_f/SP_f	7.3	0.0	0.4	2.5	2.0	0.4	2.0
AGL-Qo4	Md, UC, PR_f/PB	2.6	0.0	0.0	0.0	1.6	0.0	1.1
AGL-Qo5	Md, HC, PR_f	8.8	0.0	0.9	7.4	0.4	0.0	0.0
AGL-Qo6	Md, HC-MC, PR_f/PB	13.6	1.2	7.4	5.0	0.0	0.0	0.0
AGL-Qo7	Lg, HC, PR/PB	3.7	3.1	0.0	0.6	0.0	0.0	0.0
AGL-Qo8	Lg, HC, SP/PB	5.2	5.2	0.0	0.0	0 0	0.0	0.0
CIS-C1	Sm, HC, SP_f	83.9	0.0	0.0	5.0	2.8	24.4	51.7
CIS-C5	Md, MC-UC, PR_f/PB	1.7	0.6	0.0	1.1	0.0	0.0	0.0
CIS-Qc1	Sm, HC, SP_f	33.3	0.0	0.0	1.0	1.5	8.8	22.1
CIS-Qc2	Sm, MC-UC, PR_f	28.0	0.4	0.1	8.5	3.0	4.4	11.6
CIS-Qc3	Md, UC, PR_f/PR	16.8	6.3	9.7	0.8	0.0	0.0	0.0
CUP-C1	Sm, HC, Cas/BD	199.9	0.0	0.0	1.7	55.6	74.1	68.6
CUP-C2	Sm, HC, SP/Cas	22.9	0.0	0.0	3.3	17.6	2.0	0.0
CUP-C3	Sm, HC, SP_f/SP	24.5	0.0	0.4	11.2	10.6	2.1	0.3
CUP-C4	Md, HC, SP/BD	4 9	0.5	0.1	4.2	0.1	0.0	0.0
CUP-C5	Md, MC, SP_f/PB	3.5	0.6	0.1	2.8	0.0	0.0	0.0
CUP-C6	Md, HC, SP/PB	3.6	2.8	0.0	0.1	0.0	0.0	0.0
CUP-C8	Lg, HC, SP/PB	5.9	5.9	0.0	0.0	0 6	0.1	0.0
ROP-C7	Md, UC, BR/PB/PR_f	9.4	0.0	1.0	7.8	0.2	0.0	0.5
ROP-Qa7	Lg, UC, BR	3.7	3.7	0 0	0.0	0.0	0.0	0.0
ROP-Qc1	Sm, UC, PR_f	167.3	0.0	2.4	33.9	32.5	36.7	61.8
ROP-Qc2	Sm, HC, PR_f/SP_f	103.4	0.0	0.1	8.4	14.4	21.3	59.2
ROP-Qc3	Md, UC, PR_f/PR	44.2	18.8	13.4	11.8	0.0	0.0	0.3
ROP-Qc4	Md, HC, PB/PR_f	9.1	0.8	1.1	7.2	0.0	0.0	0.0
ROP-Qc5	Md, HC, PB/PR_f	12.1	10.8	1.3	0.0	0.0	0.0	0.0
ROP-Qc6	Md, UC, PR	9.5	9.3	0.2	0.0	0.0	0.0	0.0
ROP-Qc7	Lg, MC, PR/BR	15.2	14.1	0.0	1.1	0.0	0.0	0.0
ROP-Qc8	Lg, MC, PR/PB	2.8	2.8	0.0	0.0	0.0	0.0	0.0
SIG-L1	Sm, HC, SP_f	160.0	0.0	0.0	8.0	6.5	57.7	87.8
SIG-L2	Sm, MC,PR_f/PR	38.5	0.0	0 3	15.3	8.2	6.2	8.5
SIG-L3	Md, HC, SP_f/BD	6.3	0.0	0.5	5.0	0.7	0.2	0.0
SIG-L4	Lg, HC, PR/PB	24.2	22.8	1.5	0.0	0.0	0.0	0.0
SIG-M1	Sm, HC, SP_f	67.8	0.0	0.0	3.9	4 8	33.3	25.8
SIG-M2	Sm, MC, PR_f	18.5	0.0	0.0	7.7	4.9	4.1	1.8
SIG-M3	Md, HC, BD /PR_f	9.6	0.0	0.0	7.2	1.8	0.6	0.0
SIG-M4	Md, MC, BD/PR_f	6.0	1.1	1.4	3.5	0.0	0.0	0.0
SIG-M5	Lg, HC, PR/PB	15.1	15.1	0.0	0.0	0.0	0.0	0.0
SIG-M6	Md, UC, PR	2.3	0.0	0.9	1.4	0.1	0.0	0.0
SIG-Qa6	Lg, UC, PR	11.3	11.3	0.0	0.0	0.0	0.0	0.0
SIG-Qc1	Sm, HC, SP_f	12.8	0.0	0.0	1.7	2.4	6.6	2.1
SIG-Qc2	Sm, MC-UC, PR_f	8.9	0.0	0.0	3.2	0.4	3.3	2.0
SIG-Qc3	Md, MC-UC, PR_f	9.1	1 2	1.1	6.2	0.0	0.0	0.5
SIG-Qo1	Sm, HC, SP_f/SP	38.3	0.0	0.0	2.6	5.7	16.7	13 3
SIG-Qo2	Sm, MC-UC, PR_f	19.0	0.0	0.0	10.3	4.4	3.0	1.4
SIG-Qo3	Md, HC, PR_f/SP_f	4.8	0.0	0.0	4.7	0.2	0.0	0.0
SIG-Qo4	Md, MC, PR_f/PB	2.0	0.0	0.0	2.0	0.0	0.0	0.0
Totals		**1397.8**	**150.8**	**45.0**	**226.3**	**193.8**	**334.1**	**447.9**

The approach to stream classification adopted by the HCP principally follows the process-based approach of Montgomery and Buffington (1997) and borrows from the Washington State Watershed Analysis method by grouping channel segments of similar confinement into what could loosely be referred to as "physical response classes." However, the HCP approach differs in that it explicitly addresses geology (and therefore the character of bed and bank materials) through stratification by LTU. The purpose of classifying the channel network is to facilitate the following four activities: (1) grouping channel segments by dominant physical processes and ecological roles, (2) assigning riparian strategies that reflect important riparian forest functions in different landscape settings, (3) mapping biological resources through Simpson's GIS, and (4) facilitating the allocation of channel assessment and monitoring resources.

Channel width, the degree of channel confinement, and channel bed morphology were used to classify each channel segment. Field surveys were conducted to identify the basic channel classes and then each segment was assigned a class through the GIS using a combination of the following variables: DNR stream type, geology, LTU, and channel slope. The GIS stream segment database has over 8,200 records, each one identifying a separate segment. Channel class names are constructed of the LTU acronym followed by alphanumeric characters. The letters indicate the lithology © = Crescent formation basalt, L = Lincoln formation siltstones and mudstones, M = Montesano formation sandstone, Qa = alluvial sediments, Qc = deposits of continental glaciers, and Qo = deposits of Olympic alpine glaciers) and the number refers to the relative basin area typical of the channel class, however no direct correspondence exists between the number and channel order as described by Strahler (1957). After the initial class assignments were made, maps were produced on which corrections were made based on field familiarity with the area and additional field verifications. This process resulted in 49 different channel classes for the Plan Area, presented in Table 4.

Even though many of these size/confinement/bed morphology classes may occur in multiple LTUs, the LTU helps describe physical channel processes and ecological roles. Since these conditions represent very different conservation opportunities, these channels are assigned a different channel class. For example, in the CUP there are small, highly confined, forced step pool channels. In the SIG small, highly confined, forced step pool channels also exist. However, the physical response to management in these channels and the ecological roles they fill are very different due to their occurrence in different geology, topography, elevation and hydrologic zones.

Simpson's channel classification approach facilitates the mapping of the biological communities in the Plan Area. In this way it is a practical tool for describing the motivation behind the conservation approaches and prescriptions. Some of the biological associations are very strong. For example the SIG-L4 channel segments are important for steelhead spawning and rearing. They are also virtually the only segments that support riverine breeding western toads. Similarly the CUP-C1 channel class is the principal habitat of the Olympic torrent salamander while SIG-L2 channels often support isolated (above waterfalls) populations of riffle sculpin. The channel classification system also provides a convenient framework for assigning riparian prescriptions, evaluating riparian forest functions, managing stream habitat data, and understanding the longitudinal linkages in the channel network.

The Simpson channel classification provides a definitive biological context for designing and understanding riparian conservation prescriptions and measures. Appendix A of the HCP (STC July 2000) provides brief descriptions of the habitat requirements and distribution in the Plan Area for the 30 aquatic dependent species covered by the Plan. Species have been grouped by "associations" that represent groups of species occupying similar reach or segment levels of the channel network. This grouping facilitates the association of species with such landscape features as the dominant hillslope and channel processes that are associated with different reaches of the channel network and as such provides insight into the formative processes for their habitats. Since management prescriptions are targeted at forest management activities that often upset the natural balances of these processes the grouping also establishes a linkage between species associations and management prescriptions. Similar microhabitats of the same channel class may be used by members of a species association for completion of different life history requirements. For example, in some of the mainstem rivers of the Plan Area, western toads use the same slackwater habitat for breeding as juvenile steelhead and coho during the colonization phase of their early stream residence. These habitats are created by the same physical processes and support several species but in different ways.

Table 4. Key to channel classification scheme and its relation to riparian strategies in the Simpson HCP Area..

Channel Classifiers

Channel Width (CW)	Confinement by Valley Width (VW) to CW Ratio	Channel Bed Morphology
Small = 0 - 4 m	Highly confined = VW < 2 X CW	Bedrock = BD, Cascade = Cas, Step-pool = SP
Medium = 4 - 16 m	Moderately confined = VW 2 - 4 X CW	Forced step pool = SP_f, Plane-bed = PB
Large = > 16 m	Unconfined = VW > 4 X CW	Forced pool riffle = PR_f, Pool riffle = PR
		Braided = BR

Lithotopo Unit

Crescent Uplands (CUP)	Recessional Outwash Plain (ROP)	Crescent Islands (CIS)	Sedimentary Inner Gorges (SIG)	Alpine Glacial (AGL)
CUP-C1 = Sm, HC, Cas/BD	ROP-C7 = Md, UC, BR/PB/PR_f	CIS-C1 = Sm, HC, SP_f	SIG-L1 = Sm, HC, SP_f	AGL-Qa6 = Lg, UC, PR
CUP-C2 = Sm, HC, SP/Cas	ROP-Qa7 = Lg, UC, BR	CIS-C5 Md, MC-UC, PR_f/PB	SIG-L2 = Sm, MC.PR_f/PR	**AGL-Qo1 = Sm, HC, SP_f/SP**
CUP-C3 = Sm, HC, SP_f/SP	ROP-Qc1 = Sm, UC, PR_f	CIS-Qc1 = Sm, HC, SP_f	**SIG-L3 = Md, HC, SP_f/BD**	AGL-Qo2 = Sm, MC-UC, PR_f
CUP-C4 = Md, HC, SP/BD	**ROP-Qc2 = Sm, HC, PR_f/SP_f**	CIS-Qc2 = Sm, MC-UC, PR_f	**SIG-L4 = Lg, HC, PR/PB**	**AGL-Qo3 = Sm, HC, PR_f/SP_f**
CUP-C5 = Md, MC, SP_f/PB	ROP-Qc3 = Md, UC, PR_f/PR	CIS-Qc3 = Md, UC, PR_f/PR	SIG-M1 = Sm, HC, SP_f	AGL-Qo4 = Md, UC, PR_f/PB
CUP-C6 = Md, HC, SP/PB	**ROP-Qc4 = Md, HC, PB/PR_f**		SIG-M2 = Sm, MC, PR_f	**AGL-Qo5 = Md, HC, PR_f**
CUP-C8 = Lg, HC, SP/PB	**ROP-Qc5 = Md, HC, PB/PR_f**		**SIG-M3 = Md, HC, BD /PR_f**	**AGL-Qo6 = Md, HC-MC, PR_f/PB**
	ROP-Qc6 = Md, UC, PR		**SIG-M4 = Md, MC, BD/PR_f**	**AGL-Qo7 = Lg, HC, PR/PB**
	ROP-Qc7 = Lg, MC, PR/BR		**SIG-M5 = Lg, HC, PR/PB**	**AGL-Qo8 = Lg, HC, SP/PB**
	ROP-Qc8 = Lg, MC, PR/PB		SIG-M6 = Md, UC, PR	
			SIG-Qa6 = Lg, UC, PR	
			SIG-Qc1 = Sm, HC, SP_f	
			SIG-Qc2 = Sm, MC-UC, PR_f	
			SIG-Qc3 = Md, MC-UC, PR_f	
			SIG-Qo1 = Sm, HC, SP_f/SP	
			SIG-Qo2 = Sm, MC-UC, PR_f	
			SIG-Qo3 = Md, HC, PR_f/SP_f	
			SIG-Qo4 = Md, MC, PR_f/PB	

Riparian Strategies

Canyon	Channel Migration	**Break in Slope**	**Inner Gorge**	**Unstable and Intermittent**	Reverse Break in Slope	Te[r] S

c. Riparian Conservation Strategies

In the Plan, widths of individual RCRs are measured from the edge of the "channel migration zone" (CMZ) or the "break-in-slope" (BIS) (see Figure 1 below). Measurements are determined from the channel disturbance zone (CDZ) in instances where the channel migration zone is not well defined. The CMZ and CDZ typically includes the valley bottom where the stream may migrate over time. For most Type 1-3 streams the CMZ and CDZ are significantly wider than the OHW. The BIS is the point on the hillside above the stream where the slope gradient substantially decreases or levels out (i.e. the edge of a ravine). The measures defined for the proposed action would ensure all channel migration zones would be protected and hillside slopes adjoining those streams (below the BIS) would not be harvested.

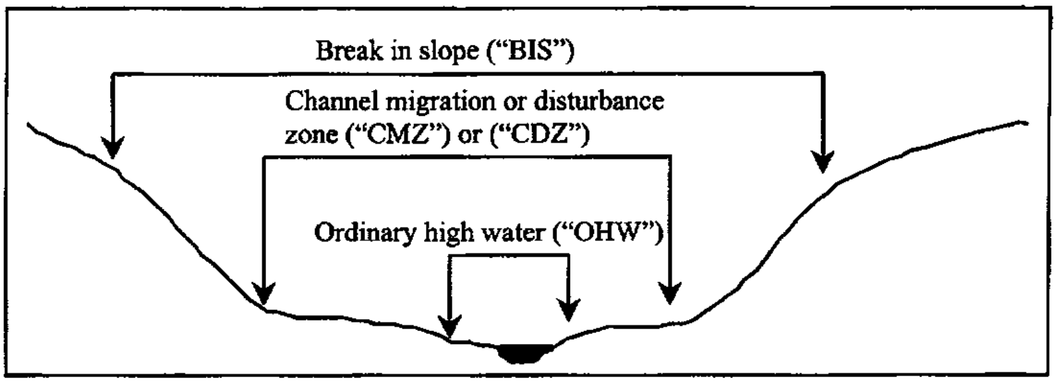

***Figure 1.** Hypothetical valley cross section showing topographic breaks and surfaces that serve as measurement benchmarks in Simpson's riparian approach.*

Eight riparian strategies are defined by identifying the functional needs of groups of closely related channel classes and the dominant interactions of each channel class groups with their riparian forest. The functional needs and dominant riparian forest interactions of each channel class are expected to be met by coupling each riparian strategy with the following:

- a point of measurement (Figure 1, above) and minimum and average widths,
- designating management guidelines for the RCR (summarized in V.B.2. of this Opinion from HCP Tables 26 and 27, STC July 2000), and
- specifying guidance for harvest unit layout adjacent to streams through narrative descriptions of each riparian strategy.

Each strategy describe the functional characteristics of groups of channel classes and integrates information about the potential vegetation in riparian settings and natural disturbances likely to occur there. Narratives provided in the HCP also are intended to provide information for

Simpson foresters to consider in the course of harvest unit layout to provide the maximum level of riparian protection within prescribed boundaries. The complete riparian management approach is described in Appendix B of the HCP (STC July 2000).

(1) Canyon Riparian Strategy

The primary management function of the *Canyon* riparian strategy is the provision of LWD from off site, and maintenance of on site shade and detrital inputs. The purpose of this strategy is to maintain the sediment and organic matter storage capacity of the upper channel network, keep convective heat transfer to a minimum and supply detritus to the channel as its principle energy source. This strategy will be applied in the Crescent Uplands (CUP) LTU unit along the highly confined channel network of the Olympic foothills. No current harvest is taking place in these stands (most were logged for the first time only in the 50's and 60's) and no streamside trees were retained at that time.

The retention of sediment behind debris dams, in otherwise sediment limited channel reaches, is the dominant physical process Simpson will be managing. If this capacity is reduced by the break up of storage structures (LWD dams), the sediment will be carried to downstream reaches where it accumulates in flatter channel segments (ROP-C7) along the foothills front boundary. Salmon and trout habitat is thus compromised by the filling of pools and loss of surface flow in the summer. There may be some opportunity for management of these riparian leave areas but the plantations are still young and terrain would require cable thinning or helicopter operations. Leave areas will not be uniform in width, but concentrated in areas that have a high probability of contributing LWD to the channel network. Leave areas will also be fashioned to maintain refugia for stream breeding amphibians.

(2) Channel Migration

The primary management function of the *Channel Migration* riparian strategy is the retention of sediment and organic matter and maintenance of nutrient processing. Numerous other riparian forest functions will be provided by default through this strategy including, bank stability and the growth of very large specimen cedar and spruce for ultimate contribution of LWD. The purpose of this strategy is to maintain the floodplain processes that contribute to nutrient processing within the soil and the hyporheic[1] zone and ensure continued development of topographic complexity of floodplain surfaces. The *Channel Migration* riparian strategy is being applied to two settings; either very large meandering alluvial channels inset within well defined terrace systems or those low gradient smaller channels with highly erodible banks, (e.g. AGL-Qa6, CIS-Qc3, or SIG-M6 channel segments in the Alpine Glacial, Crescent Islands, and Sedimentary Inner Gorges LTUs respectively).

[1] The hyporheic zone consists of subsurface gravels and interstitial waters which mix with surface and groundwater. Recent research has shown that important biological and chemical processes occur in the hyporheic zone that contribute to the productivity of surface waters.

This strategy recognizes flood flow bank erosion, including uncommon but inevitable channel avulsions as the principal disturbance agent for these channel types and their riparian forests. Cutting boundaries Table 2 and Table 3) guarantee that when channel avulsions occur, suitable riparian forest corridors will be adjacent to the new channel. The expected result due to implementation of this strategy is the continued development of floodplain complexity and micro-topography including the many types of small channels that are important for overwintering habitat of salmonids, especially coho salmon.

(3) Temperature Sensitive

The primary management function of the *Temperature Sensitive* riparian strategy is shade and the control of streamside air temperature. The purpose of this strategy is the mediation of water temperatures in channels that are vulnerable to summer time increases. This strategy is being proposed for channel class ROP-Qc3. Temperature is an issue elsewhere as well but this is an especially important channel class in terms of fish utilization and miles. Cutting boundaries should be established that provide the greatest shade from the mid-day to the early afternoon. This may result in a wider, denser leave area on south and west aspects. All of these channels have very low summer flows and ample supplies of gravel which frequently form broad riffles over which the water flows in thin layers exposing it to conductive heat transfer. Maintenance of adequate shade over these streams will provide a better rearing environment for coho, cutthroat, and steelhead.

(4) Inner Gorge Riparian Strategy

The primary management function of the *Inner Gorge* riparian strategy is the provision of LWD from unstable slopes. The purpose of this strategy is to provide wood large enough to maintain position or lodge in channel classes like SIG-L4, SIG-M5, AGL-Qo8, and AGL-Qa6 channels. Although function of LWD changes in channels of this size and the architecture of LWD accumulations is different, it is nonetheless very important to the development of productive main river habitat. Trees in second growth forests today are just approaching a size that produces functional LWD in large channels. It would be desirable for them to attain additional size before they are recruited to the main rivers. To accomplish this the timber harvest boundary is set back from directly delivering inner gorge side slopes. Floodplain complexity will be enhanced by this strategy over the long run. Maintenance or creation of this kind of habitat is important in these channels due to their relatively confined character. Growing big wood fast is the goal of this strategy. Within this strategy there should be significant opportunity for active management. However, in these areas the largest trees that have the highest likelihood of recruiting to the river must be retained.

(5) Alluvial Bedrock Transition Riparian Strategy

The primary management function of the *Alluvial Bedrock Transition* riparian strategy is the provision of LWD. The purpose of this strategy is the maintenance of an alluvial channel bed in channel classes likely to scour to bedrock in the absence of LWD. (A minimum diameter of about 0.8 m is needed before LWD is functional in these channels). This strategy will be applied along channel classes SIG-M3 and SIG-M4 channels. The principal recruitment zone for high value LWD is at and just beyond the break in slope.

Valley walls of these channel types are overlain with a thin mantle of soil which is quite unstable. The valley walls may never have produced many large conifer making it especially important to produce them on surfaces that are stable long enough to recruit trees of large size and where they will be delivered to the stream. Unless a supply of LWD is provided to these streams over time they will loose their alluvial character because they have no connection to upland channel networks where weathering bedrock and mass wasting contribute a continual flow of colluvium for fluvial processing. The focus of stand manipulation in this strategy is to grow big conifers fast, requiring considerable silvicultural intervention since many stands adjacent to these channels are dense western hemlock. Sitka spruce grows rapidly in these settings and care should be taken to release younger individuals in the understory.

(6) Break in Slope Riparian Strategy

The primary management function of the *Break in Slope* riparian strategy is the provision of LWD. A wide range of channel classes are assigned this strategy (Table 1). Cutting boundaries should be moved back away from the break in slope with emphasis being given to wind and shade protection of south and west aspects. As with the Alluvial Bedrock Transition riparian strategy, the boundary is set back to capture surfaces beyond the inner side slopes adjacent to the channel from which conifer LWD is recruited.

In the AGL, the cemented gravels of the side slope are overlain with thin soils and the boundary horizon accumulates water. Alder, salmonberry, and devils club predominate on those slopes. The smaller of these channels dry up in the summer but are used by juvenile steelhead for winter refuge. Without LWD the pools needed for winter resting are not maintained as the channel reverts to plane bed morphology. In the larger channels the same pools are needed for the maintenance of older year classes of cutthroat trout and coho throughout the year. This strategy provides ample opportunity for active management as the surfaces above the break in slope are suitable for ground based logging systems.

(7) Reverse Break in Slope Riparian Strategy

Primary management functions targeted by the *Reverse Break in Slope* strategy are the provision of LWD and nurse logs. The purpose of providing nurse logs is to maintain conifer germination sites in an otherwise unfavorable environment. LWD is needed for creating channel complexity. This strategy is being proposed adjacent to channel classes SIG-L2 and AGL-Qo4 (Table 1). The proposed cutting boundaries for these sites should retain a conifer component for establishment of large trees for eventual recruitment of LWD to the channel and the forest floor. These settings are typified by wet understory plant communities whose early seral stages are dominated by red alder. After the first logging, these sites reverted to alder and today present one of the most difficult riparian recovery challenges.

Channels traversing these valleys are low to moderate gradient and provide potentially very good fish habitat. Most of the wood left in these channels today is residual old growth and is in advanced stages of decay. Without new wood recruitment over the next several decades to direct the erosive energy of the streams in forming new pools, pool spacing will go up with commensurate loss of habitat for older year classes of trout. Red alder stands adjacent to these channels are at their peak of vigor now and will be declining over the next thirty years. The few scattered conifer saplings that can be found in the understory are currently suppressed but represent a valuable resource for the future. All conifers should be maintained in the understory and a conifer component should be retained in the outermost riparian boundary.

(8) Unstable Slopes/Intermittent Flow Riparian Strategy

The purpose of the *Intermittent Flow* riparian strategy is to maintain important functional linkages between channel segments and their riparian areas for channel classes that typically have low average fish resource value. However, this strategy explicitly recognizes that physical processes may transmit significant impacts from these channel classes, downstream to other channel segments of the same class or those of other classes that are longitudinally connected, and for which on-site biological resource value is high. This group of channel classes is highly diverse, lies at the tip of the channel network in all LTUs, and constitutes the smallest of channels but the preponderance of the total actual channel mileage. In the majority of cases, segments of these channel classes will not support fish, but within a class, there is substantial variance with respect to physical condition and the presence of particular species.

Where any species of fish are present, a 20 meter average (3 acres per 1,000 feet), no harvest, continuous buffer outside the channel disturbance zone will be retained in a pattern that optimizes functional needs for specific channel classes. See Appendix E of the HCP (STC July 2000) for more details about functional characteristics of specific channel classes. Unstable slopes adjacent to these channel classes will also be afforded continuous protection.

Where no fish are present and no instability exists, 80 trees per 1,000 feet of channel shall be retained that are representative of the pre-harvest stand size distribution and species composition. In these cases, leave trees should be clumped in patches designed to optimize the functional needs for specific channel classes. The clumping of leave trees along non-fish bearing portions of these channel classes will provide discontinuous forest fragments for recruitment of LWD and immediate protection for stream breeding amphibians in the perennial segments. The majority of segments afforded this strategy will be intermittent.

Boundaries of RCRs would be determined by functional widths or by the extent of unstable slopes, whichever is greater. The point of riparian conservation area measurement for the proposed action would be defined by stream class, and this point of measurement would incorporate the areas with the most potential for interacting with the stream. Only one channel class under the proposed action (see ROP-C7 in the HCP Appendix B) would use the 'ordinary high water mark" (OHW) as the point from which conservation area measurements would be taken. All other channel classes would use "channel migration zone" (CMZ) or "channel disturbance zone" (CDZ).

Under the proposed action, riparian conservation area widths would be measured from the edge of either the "channel migration zone" (CMZ) or the "break-in-slope" (BIS). Measurements would be taken from the channel disturbance zone (CDZ) in instances where the channel migration zone is not well defined. The CMZ and CDZ typically includes a majority of the stream valley bottom which is susceptible to stream meandering. For most Type 1-3 streams the CMZ and CDZ are significantly wider than the OHW. The BIS is the point on the hillside above the stream where the slope gradient substantially decreases or levels out (i.e. edge of a ravine).

The measures defined for the proposed action would ensure all channel migration zones would be protected and hillside slopes adjoining those streams (below the BIS) would be not be harvested.

During the first 10 years after issuance of the proposed ITP, thinning would be limited to only experimental treatments on 1,000 acres of the total 3,800 RCR acres that are available for harvest. The purpose of this thinning would be to accelerate the development of late seral forest characteristics (more than 120 years of age). The results of this management would be reviewed at the end of the 10 year period by the Services and Simpson Timber to determine whether the management is expected to reach the intended goal. Adaptive management changes may be made at that time for managing the remaining 2,800 acres. Other provisions of this management include: (1) thinned areas would be well distributed among channel classes to gain a broad sample of vegetation responses from different riparian areas; and (2) thinning treatments will vary according to the different plant associations studied and the treatments will be replicated.

Where Simpson Timber chooses to retain existing road segments, or build new road segments that lie tangential to the stream and are within the RCR, the area covered by the "footprint" of the road and the cleared road right of ways would be added to the RCR in nearby areas and would be composed of trees similar in size and species characteristics as those that would normally be found at the site.

3. Clean Water Act - Total Maximum Daily Loads

A Total Maximum Daily Load (TMDL) for temperature has been developed to address water quality concerns in the Plan Area under the authority of the federal Clean Water Act (CWA). The TMDL is actually a set of loading measures for heat energy and sediment delivery, an "other measure as appropriate" related to water temperature increases, that are stratified by lithology and topography. TMDLs are assigned to each of the 49 channel segments described in the Plan Area and serve as water quality benchmarks to monitor and assess the performance of the suite of riparian, road, hillslope, and other HCP conservation measures that affect water quality. Simpson Timber Company is expected to implement and adapt sediment and water quality conservation measures consistent with these TMDLs and with the approval and oversight of the DOE and EPA per processes specified in the CWA.

The management prescriptions for the proposed action have been assessed for their likelihood of achieving water quality standards. A Technical Assessment Report support was prepared by Region 10 of the EPA, in cooperation with the Washington Department of Ecology, Simpson Timber, and the Services (Appendix G, STC July 2000). It finds that, subject to monitoring and adaptive management requirements, the proposed management prescriptions should result in water quality levels sufficient to protect the beneficial uses of Plan Area waters. Beneficial uses include aquatic fish and wildlife (Appendix G, STC July 2000). The NMFS considers the TMDL Assessment to be an appropriate and compelling example of the best available science and information and incorporates it in this Opinion by reference. The TMDL specifically addresses the effectiveness of riparian prescriptions for protecting stream temperature, and it also addresses road and hill slope management prescriptions that can affect stream sedimentation. Chapter 9 of the HCP describes a monitoring program that would test fundamental assumptions in the TMDL and inform Simpson Timber and the federal, state and tribal governments of HCP performance regarding water quality. Additionally, the adaptive management program identified in Chapter 10 of the HCP would be used to examine the monitoring information and adjust management actions to better meet the TMDL standards. Pursuant to Chapters 9 and 10 of the HCP, the management prescriptions and conservation measures in the HCP are potentially subject to adaptation if the sediment or heat load allocations identified in the TMDL are not achieved. A comprehensive review of water quality and other monitoring data will be conducted following year 15 of Plan implementation to assess progress toward achievement of the TMDL.

4. Wetland Conservation

Stream-associated wetlands generally are conserved through riparian prescriptions providing functions along channels connecting them to flowing, fish-bearing channels. In the Plan Area these stream-associated wetlands are complexed within larger channels and channel migration zones which provide important summer rearing and winter refugia for salmonids. Conservation of other "non-forested" wetlands is important for wildlife species and for the provision and maintenance of complex surface and groundwater hydrologic processes operating at the watershed scale.

The wetland management prescriptions of the proposed action combine a Hydro-geomorphic Model (HGM) classification system (as it is being applied to forest practice regulation) with an approach to functional protection. Approximately 6,059 acres of non-forested wetlands, and an additional 4,581 acres of their conservation areas would be conserved. In addition to the non-forested wetland conservation, at least 50 percent of the forested wetland tree stem density would be conserved for forested wetlands greater than one acre. This conservation would occur through either protecting all tree stems within particular forested wetlands or by leaving some of the tree stems standing after partial harvest. In other cases, entire forested wetlands would be harvested, however, the total tree stem count would still apply for all forested wetlands.

A total of approximately 3,724 acres of forested wetlands exist in the Plan Area, and this conservation provision was estimated to eventually maintain 65 to 85 percent of those wetland acres. This total acreage of conserved forested wetlands would include areas that were partially harvested yet still maintain portions of the wetland vegetative cover, as compared with clearcutting, which would remove all cover. This analysis assumed a median point (75 percent) of the estimated range of forested wetland acreage that would be maintained in either full protection or partially thinned condition. This 2,793 acres represents Simpson Timber's best estimate of forested wetland conservation (with either no-timber harvest or thinned condition) given the current knowledge of their locations and timber harvest options and needs.

The proposed Wetland Conservation Program would be complemented by an assessment and monitoring approach to wetland function stratified by wetland class and sub-class. Road management around wetlands in the Plan Area would be directed at minimizing sediment delivery to wetlands and maintaining natural flow patterns which would stabilize water levels. The occurrence and spread of exotic plants in wetlands near roads would be monitored. Table 3. identifies the Wetland Conservation Program proposed as part of the subject action. Definitions of wetlands and the associated three management prescriptions for conservation areas (no-harvest, 50 percent stem-removal and compensating cut) are provided in Section 5.2.3 of the HCP.

5. Road Management

Where Simpson Timber chooses to retain existing road segments, or build new road segments that lie tangential to the stream and are within the RCR, the area covered by the "footprint" of the road and the cleared road right of ways would be added to the RCR in nearby areas and would be composed of trees similar in size and species characteristics as those that would normally be found at the site.

In the first year after issuance of the proposed ITP, Simpson Timber would develop a road status database, and within the first six months of issuance the proposed ITP, Simpson Timber would compile a list of known road problems. Within five years of proposed ITP issuance, Simpson Timber would systematically collect data on each road segment which would include a list of road maintenance and improvement projects on the 1,996 miles of active roads in the Plan Area. As part of this process, Simpson Timber would systematically collect data for all road segments in the Plan Area, prioritize road projects according to the greatest need for resource protection and implement those projects. Additionally, roads would also be monitored each year of the HCP for sediment contributions to streams.

Through the road inventory process, Simpson Timber would identify a permanent road system which is necessary for forestry operations. Roads that would be candidates for decommissioning are: 1) those not needed for current and anticipated future operations; 2) roads that have a high risk of failure and/or delivery of sediment to streams; and 3) roads located in riparian areas. Simpson Timber would implement a program for road decommissioning. Decommissioned roads would have all fills, drainage structures and side cast removed. Cut banks would be stabilized. Dormant roads would be cross ditched to block motor vehicle access.

Improvements would be made to road management with the overall goal of reducing sediment input into streams. These improvements would be made through a variety of methods, including: 1) temporary cessation of log hauling during periods with the greatest amounts of rainfall when road surfaces could become rutted; 2) better road surfacing; 3) improved road drainage; and 4) sediment trapping techniques. These measures also would lead to improved stream crossings, culvert size and placement, cross ditching and road outsloping. The focus of Simpson Timber's road maintenance activities would be on fixing the underlying problems, not merely addressing the symptoms.

Roads would be remediated according to the priorities identified in the road inventory. At least 25 percent of the remedial work would be completed within the first five years of the proposed ITP period, a total of 75 percent of the road remediation would be completed by year 10, and 100 percent would be completed by year 15. There would be no money expenditure limit for this road work during the first 15 years of the proposed ITP period. Thereafter, roads would be treated at a rate commensurate with the identified needs of the program but not to exceed $250,000 per year above current road management expenditures, as adjusted for inflation. Simpson Timber has three years of experience decommissioning roads and has finished 20 miles in the Plan Area since 1995. Simpson Timber expects to continue road decommissioning as an ongoing aspect of its road management program subject only to the limitation of resource commitments identified above. Assuming 10 percent of the road system, or about 200 miles, of roads need significant remediation (based on information provided by Simpson Timber), the worst of the road problems could be completed within 6-7 years.

Table 5. Wetland management prescriptions for the Plan Area by hydro-geomorphic model (HGM) classification.

Riverine	Flow-through impoundments	Forested Scrub/shrub Emergent Aquatic bed	Any	No harvest will occur in forested riverine wetlands of either HGM sub-class; conservation areas on riverine wetlands will be established consistent with management prescriptions for the establishment of RCRs.
Depressional	Outflow Closed	Forested	> 1.0 acre	If associated with a permanent or seasonal hydro-period, protection will be provided either by a no-harvest or a 50 percent stem removal management prescription. If associated with an occasional or saturated hydro-period, protection will be provided by either a no-harvest, 50 percent stem removal or a compensating cut management prescription.
	Outflow Closed	Emergent	> 0.5 acre	Inner 10 m (33 ft) conservation area with a no-harvest management prescription and an outer 10 m (33 ft) conservation area with a 50 percent stem removal management prescription.
	Outflow Closed	Scrub shrub	> 0.5 acres	Inner 10 m (33 ft) conservation area with a no-harvest management prescription and an outer 10 m (33 ft) conservation area with a 50 percent stem removal management prescription.
	Outflow Closed	Aquatic bed [c]	0.25 acres	Inner 10 m (33 ft) with a no-harvest management prescription and an outer 30 m (99 ft) conservation area with a 50 percent stem removal management prescription.
Slope		Forested	Any	If associated with unstable slopes, no harvest is permitted.
		Forested	> 1.0 acre	If associated with stable slopes, area may receive a compensating cut or 50 percent stem removal management prescription.
Flats		Forested	> 1.0 acre	Protection provided by either a no-harvest, 50 percent stem removal or a compensating cut management prescription.
		All others	> 0.5 acre	Inner 10 m (33 ft) conservation area with a no-harvest management prescription and an outer 10 meter conservation area with a 50 percent stem removal prescription.

[a] **Bogs:** All bogs > 0.25 acres in size would be protected. Conservation area widths would be those identified for the type of wetland where the bog is located.

[b] **Permanent hydro-period:** Standing water year-round.
Seasonal hydro-period: Standing water at least one continuous month during the growing season.
Occasional hydro-period: Standing water less than one continuous month during the growing season.
Saturated hydro-period: Water table within one foot of the surface at least one continuous month during the growing season.

[c] **Aquatic bed:** Must have 0.25 acres of open water with characteristic floating or submergent wetland vegetation of this class.

Road management is described in detail in Section 6 of the HCP (STC July 2000). Briefly, a qualified geo-technical expert would be retained for analysis of any new road construction or road reconstruction in areas where there is a high risk of hillside failures that would damage aquatic resources. Simpson would reduce delivery of sediments to stream from active logging roads by implementing a variety of methods, including the conduct of storm patrols to keep culverts open and prevent road prism erosion, and avoid construction of new roads on hillsides with greater than 60 percent slope. The following guidelines also would be implemented by Simpson Timber: 1) all crossings of fishbearing streams would provide for a natural stream bed and upstream migration of juvenile fish, 2) all channel crossings would accommodate 100 year flood flows, 3) driveable dips, crowning, and outsloping of roads would be used, 4) flumes and/or energy dissipaters would be installed and maintained to prevent erosion from culverts, and 5) relief culverts and ditches would be installed and maintained to prevent transfer of water between small catchments, and excessive water run-off onto unstable slopes.

6. Unstable Slope Management

Simpson Timber would not harvest timber on unstable slopes, and new roads would not be constructed on unstable slopes unless no other option exists that is operationally feasible. Unstable slopes would be identified through the following process.

Within five years after the issuance of the proposed ITP, Simpson Timber would complete a analysis of slope stability throughout the Plan Area that delineates unstable slopes and provides specific guidance for delineating unstable slopes where formal Watershed Analysis has not been conducted. The methods used for these analyses will be at least as rigorous and detailed as those required for a Level II Watershed Analysis under the Washington State methodology. The personnel performing these analyses will have qualifications that exceed those required for certification to perform Level II Watershed Analysis under the Washington State methodology.

Prior to a complete inventory of slope stability, Simpson Timber would use all existing information associated with mass wasting reports, causal mechanism reports and prescriptions currently set forth in the existing three Watershed Analyses completed for the Plan Area. This information would be used to delineate analogous unstable slopes in unanalyzed portions of the Plan Area pending a comprehensive analysis of the entire Plan Area.

7. Hydrologic Maturity Management:

Simpson Timber would manage seven sub-basins in the rain-on-snow zone for hydrologic maturity (total of approximately 7,1936 acres). At least 50 percent of this area would be maintained in hydrologically mature forest canopy cover, and no more than 25 percent would be in hydrologically immature cover. Forest cover for this prescription would follow the definitions within the Washington State Forest Practices Board Manual: Standard Methodology for Conducting Watershed Analysis, Version 3.0, November 1995. That manual defines hydrologically mature forest cover as stands with greater than 70 percent total crown closure that are less than 75 percent deciduous.

8. Adaptive Management

Under the proposed action, Simpson Timber would be directly responsible for conducting surveys and studies to monitor the results of their management and this information would be used by Simpson Timber and the Services to assess how well the results meet the requirements of the HCP and ITP (Sections 8 and 9, STC July 2000). Studies are proposed to specifically address the effectiveness of the HCP to conserve covered species. Adaptive management that results from such action could result in changes to Simpson management practices (HCP Chapter 10). No additional land or water resources would be required for conservation purposes unless mutually agreed to by the Services and Simpson Timber, or unless as required by changed circumstances as defined in the IA.

A prominent feature of the proposed adaptive management program is how information may be used to adjust priorities and methods for effecting road management activities as specified in Section 5.2.5. It is important to recognize that the cost of road remediation activities within the first 10 years of Plan implementation is not restricted. However, Simpson will not be required to expend more than $250,000 expressed in constant 1999 dollars (i.e. the amount will annually be adjusted for inflation) for road-related work in any one year after the fifteenth anniversary of the date on which the ITP is first issued, provided that routine maintenance of active roads and construction of new roads will be expensed from Simpson's normal road maintenance and construction budget without charge against the $250,000 cap. In some exceptional cases, an active road may suffer a catastrophic failure. For example, an undersized culvert may plug and cause a fill to wash out. Subject to the limitations set forth in the following sentence, a repair of such a failure will constitute road-work which may be charged against the annual cap as long as the repair is done in accordance with new road construction standards. In no event, however, may more than 20% of the annual budget cap be allocated for the repair of catastrophic failure of active roads and in no event may any portion of the annual budget cap be allocated to the repair catastrophic failures of roads first constructed after the date the ITP is issued. All such exceptional cases will be reported in the annual compliance report to the Services.

Another important feature of the adaptive management proposal for riparian areas is that an Adaptive Management Acreage Account (AMAA) will be set up on issuance of the ITP. The purpose of this account is to anticipate that monitoring and general increased knowledge about riparian functions and management will increase and likely require that additional acreage be conserved to accomplish goals of the Plan. Simpson will be deemed to have "deposited" an initial credit of 920 acres to the AMAA. The AMAA will then be either drawn down (debited) or increased (credited) based in each case on changes in the total acres in the Plan Area, on changes made through adaptive management in the number of acres subject to timber harvest restrictions or on changes in wildlife leave tree restrictions. Specifically, and as described in Section 10.5.2.3 of the HCP, an AMAA debit will be made to the account: (a) on a one for one basis for each additional Restricted Acre added through adaptive management; (b) on a basis of one acre for 160 stems for additional wildlife leave trees required to be left; and (c) on a basis of .0035 acres to one for each acre deleted from the Plan Area. An AMAA credit will be made to the account: (a) on a one for one basis for each Restricted Acre removed through adaptive management; (b) on a basis of one acre for each 160 stems of wildlife leave trees no longer required to be left; and (c) on a basis of .0035 acres to one for each acre added to the Plan Area. A "Restricted Acre" is any acre in the Plan Area that at the time of harvest is subject to complete or partial restrictions on harvest (e.g. acres contained within a riparian management zone and a harvest unit).

VI. ANALYSIS OF EFFECTS

A. Evaluating the Proposed Action

The Federal action that is the subject of this Biological Opinion is NMFS' issuance of an Incidental Take Permit to Simpson Timber Company. The purpose of interagency consultation under Section 7 of the ESA is to ensure that Federal actions will not jeopardize the continued existence of listed species or adversely modify or destroy critical habitat. For actions that cover permits of long duration, such as Incidental Take Permits, the ability of the NMFS to specifically identify effects such as the death or injury of individual fish is limited. The analysis of effects on covered species is achieved by analyzing the effects on ecological processes that covered species rely on, including designated critical habitats. This analysis is accomplished through an examination of covered activities, their direct and indirect effects on habitat, and the effects of HCP's measures on the conservation and recovery of habitats and the processes that create them.

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 C.F.R. Part 402 (the consultation regulations). The NMFS must determine whether the action is likely to jeopardize the listed species and/or whether the action is likely to destroy or adversely modify critical habitat. This analysis involves the initial steps of (1) defining the biological requirements and current status of the listed species, and (2) evaluating the relevance of the environmental baseline in the action area to the species' current status throughout the listed ESU.

Subsequently, NMFS evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NMFS must consider the estimated level of mortality attributable to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed salmon's life stages that occur beyond the action area. If NMFS finds that the action is likely to jeopardize, NMFS must identify reasonable and prudent alternatives for the action.

Furthermore, NMFS evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' designated critical habitat. The NMFS must determine whether habitat modifications appreciably diminish the value of critical habitat for both survival and recovery of the listed species. The NMFS identifies those effects of the action that impair the function of any essential element of critical habitat. The NMFS then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NMFS concludes that the action will adversely modify critical habitat it must identify any reasonable and prudent measures available.

Guidance for making determinations of jeopardy and adverse modification of habitat are contained in *The Habitat Approach, Implementation of Section 7 of the Endangered Species Act* *for Actions Affecting the Habitat of Pacific Anadromous Salmonids*, August 1999 (Appendix to this Opinion).

For the proposed action, NMFS' jeopardy analysis considers direct or indirect injury to and mortality of covered fishes attributable to the action. Subsequently, NMFS evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NMFS must consider the estimated level of mortality attributable to: (1) collective effects of the proposed or continuing action, (2) the environmental baseline, and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed salmon's life stages that occur beyond the action area. If NMFS finds that the action is likely to jeopardize, NMFS must identify reasonable and prudent alternatives for the action.

Furthermore, NMFS evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' designated critical habitat. This critical habitat analysis considers the manner and extent to which the proposed action affects the function of essential habitat elements necessary for the life history of the covered species compared to the existing environmental baseline. The NMFS must determine whether habitat modifications appreciably diminish the value of critical habitat for both survival and recovery of the listed species. The NMFS identifies those effects of the action that impair the function of any essential element of critical habitat. The NMFS then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NMFS concludes that the action will adversely modify critical habitat it must identify any reasonable and prudent measures available.

For this analysis, NMFS considers the potential effects of timber harvest and road use and management to be the prominent habitat-modifying activities under the baseline. Each of these activities also receive significant treatment in the conservation program proposed in the HCP. Accordingly, these activities receive more attention in this Biological Opinion.

1. Timber Harvest

As a general matter, timber harvest is the covered activity with the greatest capacity to modify habitat on the covered landscape. The manner in which the HCP prescribes timber harvest is addressed in the HCP's provisions covering Riparian Conservation Reserves (HCP section 5.2.1), Wetland Conservation Program (HCP section 5.2.3), Unstable Slopes Management Program (HCP section 5.2.5), and Hydrologic Maturity (HCP section 5.2.6). The conservation elements of these sections are summarized in section V of this Opinion. As proposed, timber harvest or logging in riparian areas would result in removal of some riparian canopy and disturbance of natural riparian vegetation. No harvest will occur within the channel migration zone (CMZ) or channel disturbance zone (CDZ) along perennial streams within the Plan Area, or within those potentially covered lands allowed to be added for coverage per section 10 of the IA.

Over time, 219,001 acres of the 261,575-acre Plan Area could be subject to regenerative timber harvest methods (e.g. clearcutting), except where roads and other natural or artificial features preclude tree growth. No salvage of dead or downed trees would be permitted within the RCR conservation areas. Timber harvest unit size would be restricted to up to 240 acres in size. Approximately 22,191 acres of riverine riparian area would be conserved in the Plan Area, with conservation along all stream classes. 42,574 acres out of the 261,575-acre Plan Area would receive partial or full conservation/protection (see Table 7 of the HCP, STC July 2000); this would provide partial or full conservation/protection of at least 16.3 percent of the Plan Area, much of which is forested (other portions are made up of active stream/river channel or are otherwise non-forested). Most of the remaining 219,001 acres of the Plan Area would be subject to regeneration harvest.

Timber harvest and associated activities could also reduce stream shading and channel stability, increase fine sediments in spawning gravels and filling of substrate interstices, reduction in pool habitats, alteration of the nutrient balance and physical character of streams, reducing cover and overall stream community complexity, reduce leaf litter delivery and large wood recruitment to streams, and restriction of natural movements of juvenile and adult aquatic species (Spence *et al.* 1996). Each of these elements are indicators of functional aquatic habitat. The following discusses the effects on each of these indicators as processes that create and maintain salmonid habitats and the effects of conservation measures and management prescriptions in the Simpson HCP that are designed to avoid, minimize and mitigate timber harvest effects on critical habitat and properly functioning conditions for listed and unlisted salmon species.

a. General Effects on the Flat Tributary Species Group

Under the HCP, coho and chum salmon are included in the flat tributary species group (HCP Table 1, STC July 2000) and populate some of the most productive and important fishbearing channel classes in the Plan Area. These channel classes include the CIS-Qc3, ROP-Qc3, 5, 6, 7, and AGL-Qo5, 6, 7. Potential effects on this species group include those resulting from the deposit of coarse sediment, the accumulation of fine sediment in spawning gravels, and elevated water temperatures. (See Table 18 and the discussion of potential impacts on aquatic species in Section 7.2.1 of the HCP, STC July 2000). Coarse sediment is delivered to channel classes supporting the flat tributary species association from multiple upstream sources, side slope failures, and lateral erosion of banks and low terraces. Fine sediment is delivered through the same processes and through surface erosion of the running surface and ditch line of forest roads. Water temperatures may be elevated through the reduction of density in the riparian forest canopy and changes in channel geometry associated with coarse sediment accumulation. Other general effects can be described from syntheses of scientific studies (e.g. Spence *et al.*1996, Murphy 1995) and are addressed further in this section.

The effects of large accumulations of coarse sediment in low gradient channels can lead to the loss of surface flow and death of individuals in those reaches while coarse and fine sediment deposited on the channel bed could entomb salmonid larvae. The effects of elevated water temperature may make stream habitat inhospitable to individuals inhabiting these reaches. In the case of temperature, the actual agent of harm may be heightened susceptibility to disease or predation. However, with management under the HCP, it is unlikely that temperatures would reach lethal levels even in the most extreme circumstances.

b. Effects on the Mainstem Species Group

Chinook salmon, pink salmon and steelhead are analyzed together in the HCP as the mainstem species group. Mainstem channel classes include ROP-Qa7, Qc7, 8, SIG-L4, M5, and AGL-Qa6, Qo-8. Members of the mainstem species association could be impacted in much the same ways as those in the flat tributary association discussed above. (See Table 18 and the discussion of potential impacts on aquatic species in Section 7.2.1 of the HCP, STC July 2000). The direct linkages to the effects of timber harvest and associated activities (e.g. roads, discussed further in this Opinion) are more difficult to demonstrate for this species group. This difficulty stems from the challenge of discriminating site-specific cause and effect relationships between timber harvest activities that are conducted predominantly high in the drainage network along small channels (e.g. CUP-c1,-c 2 channels) with in-channel habitat conditions that occur much further downstream in mainstem channel classes that provide the vast majority of habitats for all life-stages of this species group. Potential effects on this species group are predominantly those that occur from altered processes proximal to mainstem channel classes (e.g. mass-wasting sediment delivery, loss of riparian canopy and water temperature elevation) and altered processes upstream in the network of channels and riparian areas (e.g.increased sediment delivery/transport, decreased inputs of LWD, increased water temperature) that cumulatively affect habitats in mainstem channels.

Impacts to mainstem habitats in larger channels could occur as a consequence of local, management-influenced landslides, such as occurred in SIG L4 channel segment at river mile 29 on the West Fork Satsop River, March 1997 (P.Peterson, STC, Personal Communication, October 2000). However, such catastrophic events large enough to substantially alter a mainstem river channel usually have large contributing natural factors, such as the lateral erosion of landslide toes by the river. In addition, these events often contribute significant volumes of LWD that naturally serve to ameliorate the local and downstream effects of sediments on channel structure and are then available to the fluvial system as structural elements and allocthonous material with decadal benefits to fish habitats and macroinvertebrate communities downstream. Reeves *et al.* (1995) provide a substantive treatment of the dynamic and beneficial effects of disturbances on riverine-riparian ecosystems used by anadromous salmonids. One conclusion they reach is that simply designating reserves and expecting those to function as such for extended periods may be unrealistic; some benefits may accrue in the short term, but in the long run it is unlikely that habitats of sufficient quantity and quality will be available to sustain ESUs of anadromous salmonids. Thus, the effect of local mass-wasting disturbance on mainstem habitats for this species group is expected to be minimal and over time will contribute to properly functioning conditions in critical habitats for both Puget Sound chinook and Hood Canal chum salmon, along with habitats for covered anadromous species. As discussed further in this Opinion and described in Section V.B (Proposed Conservation Measures to Avoid, Minimize, and Mitigate Take), a suite of management provisions proscribe harvest on unstable slopes, conserve riparian functions, and reduce sediment inputs from roads that conserve and recover productive habitats for all salmonids in mainstem channel classes . The effect of these provisions, when added to the environmental baseline, avoid or minimize sediment delivery to aquatic systems from management-related mass-wasting.

c. Riparian Canopy and Water Temperature

As with landslides, some effects on this mainstem species group could occur through changes in riparian canopy along mainstem channel classes. Linkages between timber management activities and temperature effects in the mainstem environment are, however, tenuous due to the naturally open canopy of large channels. In the Plan Area undisturbed riparian areas generally progress towards late seral staged woody (mixed hardwood and conifer) vegetative communities. Few, if any riparian areas are unable to support either late seral riparian vegetation or tall growing herbaceous vegetation. Furthermore, the climate and topography are well suited for growth of large woody vegetative species in riparian areas. As channels become wider, larger riparian reserve widths are need to provide more effective shade, as well as to protect other riparian functions. This is reflected in the Simpson HCP where wider channels receive wider riparian reserve widths. For example, the ROP-Qc8 channels average approximately 80 feet in width and are prescribed riparian reserves approximately 96 feet wide, which is supplemented by the width of an unharvested channel migration zone nearest the active channel. The EPA conducted a rigorous analysis of the Simpson HCP riparian prescriptions to determine their effectiveness in providing shade and achieving water temperatures beneficial to salmonids and other uses. The relationship between effective shade and channel width is specifically addressed in the TMDL Technical Assessment Report (Appendix G, STC July 2000) and notes that there are situations where vegetation height associated with a mature riparian forest is not tall enough to shade the entire active channel. For instance, on June 21 the shadow length of a 170 foot tall Douglas fir at 1 p.m. (daylight time) is only about 75 feet. Thus, timber harvest activities that result in riparian reserves along mainstem channels, particularly migrating channels, are not expected to significantly impact riparian shade function or cause deleterious increases in water temperature.

Potential effects on the mainstem species group are greatest from timber activities that modify the complex interaction of sediment and solar radiation in channels upstream of the mainstem channel habitats and increased summer water temperatures throughout the system. Temperature is one of the factors that contribute to quality of habitat for fish. The relationship between water temperature and salmonid behavior and health is well documented (see for example Bjornn and Reiser in Meehan 1991; Chapter 5.2 in Spence *et al.* 1996). In general, summer- rearing chinook, coho, and steelhead stand to be potentially affected by elevated water temperatures. The individual effects to fish include increased energy expenditures to seek favorable water temperatures and to maintain metabolic processes, reduced feeding, reduced growth rates, increased susceptibility to predation, and susceptibility to disease and parasites. In the Simpson HCP, the potential effects of timber harvest on water temperature are addressed primarily through prescribed riparian reserves and limitations on sediment delivery through unstable slope management and road maintenance, decommissioning, upgrading and disconnection from aquatic systems. This suite of conservation measures is expected to improve summer water quality (particularly stream temperature) in higher elevation channel networks. The net effect is to improve water quality, over time, in mainstem channel classes that conserve and recover productive habitats for all salmonids . The specific effect of these provisions is to avoid or minimize increases in water temperature from timber harvest activities. The NMFS derives additional assurances that properly functioning water quality will be achieved through the effective shade and sediment TMDLs developed by the EPA for the Plan Area.

The EPA analyzed the processes that affect water temperature across the Plan Area in preparation of the TMDL for temperature (Appendix G, STC July 2000). The development of the TMDL used information about riparian management and other land management measures proposed in the Simpson HCP to develop load allocations for sediment and effective shade. While complex, a synthesis of the TMDL analysis shows that riparian and sediment management under the HCP are likely to achieve water quality targets that meet beneficial uses.

d. Hydrology

Timber harvest and associated activities could cause increased peak flows and channel disturbance downstream, but the HCP's conservation programs addressing riparian conservation and hydrologic maturity are designed to reduce and minimize those effects, compared to the baseline. In the steep and high-rainfall forests of Oregon, Washington, and British Columbia, mass movements of soil are the dominant erosional process (Chamberlin *et al.* 1991). Chamberlin *et al.* found that many of these mass movements originated on open areas after logging, with increases in frequency ranging from two to 31 times. Because of vegetation removal, logging can also change evapotranspiration rates and soil water content, with resulting increases in annual runoff (Chamberlin *et al.* 1991). Soil compaction from harvest activities can change infiltration rates and therefore runoff and erosion rates (Chamberlin *et al.* 1991). The HCP's conservation program addressing unstable slopes and hydrologic maturity would reduce and minimize the effects of mass movement related to timber harvest, compared to the baseline. Unstable slope management provisions specifically proscribe harvest on unstable slopes. Furthermore, under the HCP's hydrologic management prescriptions, some portions of the Plan Area (primarily the Crescent Uplands) will be managed to provide at least 50% of the area in each sub-basin with hyrdrologically mature forest (HCP Section 5.2.6, STC July 2000). Taken together the effect of these provisions avoid or minimize sediment delivery to aquatic systems from management-related mass-wasting and contribute to the proper function of instream habitats for all covered salmon species in the Plan Area..

e. Nutrients

Nutrients are directly lost to the ecosystem through the removal of trees. Harvest intensity (i.e. proportion of forest canopy removed), type of harvest (logs or whole tree) and cutting frequency all affect the rate of nutrient removal from the system (Beschta *et al.* 1995). Despite the loss of nutrients stored in removed biomass, nutrients are generally more available to stream organisms in the years immediately following harvest. This results in part from the addition of slash to the forest floor (Frazer *et al.* 1990), accelerated decomposition of organic litter resulting from increased sunlight reaching the ground (Beschta *et al.* 1995), increased water availability for leaching of materials, and increased overland runoff and erosion that contributes unbound (nitrate and ammonium) and bound(orthophosphate) nutrients to the stream (Gregory *et al.* 1987). Where logging reduces riparian vegetation, nutrient supply to the stream (e.g., leaf litter and woody debris) may be reduced. As soils stabilize and revegetation occurs, the nutrient flux declines, though nutrients from herbaceous plants in the riparian zone add high quality materials that easily decompose. Over time herbs, shrubs, deciduous trees, and conifers provide allochthonous inputs to the stream for nutrient uptake.

f. Riparian Conservation

Riparian conservation measures in the Simpson HCP are foremost in improving trends in baseline conditions, conserving and improving properly functioning conditions of habitat for all covered species and avoiding, minimizing, and mitigating effects on critical habitats within and downstream of the Plan Area. Riparian conservation measures are described in Sections II. and V. of this Opinion and discussed below as they relate and integrate with other prescriptions and conservation measures in relation to habitat-forming processes for all covered salmonids. Simpson estimates that a total of 30,219 acres or 11.6 percent of the Plan Area, will be included in the RCR . The RCRs will be distributed throughout the Plan Area along all stream classes and will encompass riparian areas, wetlands, and some contiguous unstable upland areas. Riparian forests are some of the most diverse ecosystems in the Plan Area and are critically important in providing the ecological components of healthy streams.

Aquatic ecosystems are strongly connected to the terrestrial landscape through which they flow. The streamside or riparian forest is the direct linkage between these two systems and the condition of the riparian forest along with the geomorphic setting, determines the character and quality of the aquatic habitat. Inputs from the riparian forest moderate, buffer, or control the physical, chemical, and biological processes within the channel network at several temporal and spatial scales. Mediation or maintenance of these physical processes and ecological functions is important for the survival of particular species and entire aquatic species associations.

The following functions of riparian forests are the focus of the HCP's management prescriptions: 1) wildlife habitat, 2) recruitment of woody debris to streams and forest floor, 3) shade and control of streamside air temperature, 4) stream bank stability, 5) detrital (nutrient) inputs, 6) capture and storage of sediment and organic matter on the floodplain, 7) maintenance and augmentation of nutrient dynamics and processing, and 8) provision of nurse logs. The importance of any one of these functions at any given site will depend on its location in the landscape and in the channel network and/or the specific geomorphic context of the setting. The maintenance and development of these functional interactions of riparian forests with the stream environment is the focus of the riparian management under the HCP.

In considering how to maintain adequate wood loading in the channel network, Simpson evaluated how log recruitment processes vary in each LTU and what the dominant recruitment mechanism is for each channel class. This was a critical step in the development of both the functional boundaries (e.g. the CMZ and CDZ) and the unstable slope boundaries (e.g. the break in slope) as well as for the narrative descriptions for each riparian strategy (described in Section V. of this Opinion and Section 5.2.5 and Appendix B of the HCP, STC July 2000). In general, the principal recruitment processes for logs are: mass wasting, bank erosion, (including channel avulsions on large meandering systems) and windthrow. To a much lesser degree, suppression and natural death of trees through vegetative succession is an additional process, but the recruitment of those trees is normally triggered by wind (although they sometimes may fall due to lack of structural support entirely unaided by the wind). Considered together, this last process is the least important of the four in supplying wood to channels of the Plan Area.

Simpson's strategy of riparian and stream management focuses on setting the landscape up for productive habitat development when natural disturbances occur. It is just these disturbances in fact that Simpson's riparian strategies anticipate. For example, it is expected that 100% of all the possible logs that might recruit to the channel network owing to floods and erosion of lands within the channel migration zone will occur under HCP management because all those lands are given 100% protection. The same holds true for recruitment from mass wasting. Since all of the delivering unstable slopes are protected from harvest, the full potential for supplying logs will be preserved. In the case of windthrow, Simpson modeled its riparian prescriptions after the conclusions reached from analyses of riparian monitoring studies (see Figure 17, Appendix E, STC July 2000). It is expected that approximately 75% of the wood loading (based on a conservative definition) due to windthrow will be realized. In actuality this figure will be much higher because it will include a higher per piece wood volume from trees close to the stream. The further away trees are from the stream, the lower per piece volume they contribute owing to taper in the bole of the tree.

These different recruitment processes do not affect all channel classes equally. However, in the development of its riparian strategies, Simpson has endeavored to capture the most important or dominant process for each channel class. Therefore it is expected that somewhere between 75 and 100% of the potential log recruitment will be preserved by HCP management for all channel classes (HCP STC July 2000). Due to the highly variable nature of wood loading in streams, even under unmanaged conditions, for all channel classes, this level of wood loading will be virtually non-detectable from 100% of the landscape and channel segment potential. This is not to say however, that all riparian lands of the Plan Area today are immediately capable of supplying the number and character of logs that represent the landscape and channel segment potential, as many of these trees were removed during previous harvest. The landscape is now in various stages of forest succession and stand age and HCP management will preserve these stands promoting their development for present and future functional contributions to riparian and stream ecosystems.

g. *Unstable Landforms and Mass-wasting*

Riparian Conservation Reserves are designed to protect unstable landforms near streams such as steep slopes or particularly erodible soils (e.g. inner gorges in the SIG LTU in the western portion of the Plan Area), thus avoiding or minimizing (or reducing the effects of) direct inputs of coarse and fine sediments to streams. Similarly, inventory and identification of unstable hillslopes that Simpson Timber proposes to leave unharvested and unroaded will further avoid or minimize inputs of coarse and fine sediments to streams. RCRs located beneath hillslope failures are likely to provide some trapping and sorting of colluvial sediments and thereby minimize the effects of any such failures. Where natural or management-related hillslope failures pass through and entrain portions of RCRs, the LWD recruited from riparian areas to the stream channel can serve as structural roughness elements to sort and store sediments at the stream reach scale and minimize effects on downstream habitats, particularly when creating jams or rafts in the stream channel. The recruitment of LWD through such catastrophic disturbance events adds structural complexity for all salmon species life stages and is generally recognized as a primary mechanism by which instream habitats are created and maintained (see Reeves *et al.* 1995). Thus provision of RCRs is crucial to the conservation of all salmon habitats across the Plan Area and the self-sustaining processes expected to maintain and recover them.

h. Debris Flows

Timber harvest and forest roads have the potential to alter instream habitats through the generation and propogation of debris flows and dam-burst floods. Landslides in forested environments in the Pacific Northwest can transform into debris flows or dam-break floods, often considered to the most damaging to aquatic resources (Benda *et al.* 1997). A debris flow is a highly mobile slurry of soil, rock, vegetation and water that can travel thousands of yards from its point of initiation and usually occurs in steep (greater than approximately 6 degrees) and confined mountain channels. Velocity reduction and major deposition of debris torrent [flow] material occur when channel gradients decrease below about 7 or 8 degrees (Swanston, *in* Meehan 1991). Work by Benda (1985a, 1985b) in the Oregon Coast Range suggests that the actual behavior of debris [flows] and their effects on streams results from a combination of geomorphic and hydrologic factors including junction angle, channel gradient, and magnitude of stream discharge. Deposits of landslides and debris flows may temporarily block a stream valley causing a small pond to form. The failure of such a dam can release a small flood wave that may destroy riparian vegetation and cause significant local stream erosion (Benda *et al.* 1997). Coho and Burges (1993) studied these migrating organic dams and found that valley width may be more important than channel slope in governing where these events can travel. They also found that migrating organic dams can occur in the same steep channels as debris flows but that they can travel long distances through much lower gradient channels. The effects of debris flows were summarized by Swanston (*in* Meehan 1991). Effects include alteration of the channel cross section and profile, changes in pool-:riffle ratio, alteration of the availability and viability of spawning and rearing habitats, and development of new habitat areas. New large woody debris dams and sediment wedges are commonly created at, and immediately below, points of entry (of the landslide); bed-load shifts alter habitats or resident fish and benthic organisms; and availability and distribution or oxygen-bearing intragravel water is substantially altered. Over the long run, such effects tend to concentrate biological processes at debris flow sites (Sedell and Dahm 1984). For example, Everest and Meehan (1981b, cited in Meehan 1991)) found decreased spawning and rearing habitats and decreased fish biomass immediately below recent debris flow deposits: a 90% reduction of salmonid biomass in small streams and a 55% reduction in large streams. Within 3 years after the debris flow, however, productivity has returned to nearly preflow levels. Pools created by the new debris supported increased fish populations and created more spawning and rearing habitats than existed preciously. These pools produced underyearling coho salmon at rates 10 times greater than did reaches with no debris flow pools. Minimization of the effects of debris torrents has benefits for all life stages of covered salmon species. Overall, the adverse effects of debris flows and dam-burst floods on habitats for covered species may be short-lived and be beneficial as long-term, self-sustaining processes that create and maintain properly functioning conditions within the Simpson Plan Area, in keeping with the disturbance-based ecosystem approach advanced by Reeves et al (1995).

i. Summary

Riparian stands that are marginally functioning or degraded under the baseline are expected to continue to grow and achieve properly functioning conditions. Riparian management strategies (described in Section II. B. of this Opinion) are expected to conserve and create riparian areas that optimize function based on the stream channel and geomorphic setting. Ecological functions to be provided in riparian areas across the Plan Area: shade, nutrient input, bank stability and large woody debris (LWD). Each of these are elements of properly functioning riparian habitat and contribute to the value of critical habitat. Across the Plan Area, riparian reserves along perennial non-fishbearing streams will contribute LWD, provide shade, reduce channel erosion and mass-wasting, contribute to the sorting and storage of sediment and, collectively, improve water quality and provide significant improvements in critical habitats conditions in habitats downstream for fishbearing waters. Specifically, Riparian Conservation Reserves on fishbearing streams will provide for the growth and development of a properly functioning riparian zone, that will provide over the life of the HCP the following riparian functions - sufficient shade, bank stability, litter inputs for nutrient supply, and a continual source of LWD for instream structural elements important to all anadromous fishes. Increases in LWD will create deeper pools for returning adults and summer rearing juveniles, more hiding cover for juveniles, and more habitat complexity and capacity for winter rearing juveniles. Though instream habitat and riparian functions are reduced from historical levels throughout the Plan Area, the creation and conservation of riparian forests through this HCP will help to restore instream and riparian habitat across the Plan Area. Thus, the riparian conservation measures in this HCP will most likely continue to increase the productive potential of anadromous salmonids in the HCP area and increase the quality and quantity of critical habitats. As a result, the value of these habitats to the survival and recovery of the covered species is increased.

The substantial effects of timber harvest on elements of the species critical habitat will be avoided, minimized or mitigated through measures and mechanisms described above and in Section V. B. of this Opinion. Ecological processes affected by timber harvest include riparian function, sediment production and routing to stream channels and hydrology, as these translate over various temporal and spatial scales to maintain and recover habitats for both listed and unlisted anadromous salmonids in the Plan Area. These effects, along with those of alternative timber harvest strategies, are further described in the Services' *FEIS* (Section 4.8 and summarized in Table 4.11). The HCP provides a suite of riparian, unstable slope, and hydrological prescriptions and conservation measures that address timber harvest effects that are known to directly and indirectly affect aquatic and riparian ecological processes that, in turn, are dominant controls on habitats for covered salmon species. The application of these conservation measures is expected avoid or minimize the effects of this covered activity on these elements of salmonid habitat.

2. Road Construction, Maintenance, and Decommissioning

Road building and other road management activities would likely result in loss of habitat for covered species where vegetation (particularly larger trees and snags) or other habitat features are removed or damaged for clearing of road rights-of-ways. Road construction and maintenance would have potential to cause long-term increased sedimentation effects to local and downstream waters. Riparian conservation areas, as proposed, would not likely capture sediment loads expected to result from the existing road network or those roads yet to be constructed. The effect of increased sediment delivered to streams would be similar to those effects of sedimentation discussed above in relation to timber harvest.

a. General Effects of Forest Roads

The effects of the generation and delivery of sediments from forest roads is well documented in the literature. Everest *et al.* (1987) found that logging roads, not the tree harvesting practices themselves (unless both sides of a stream bank were clear-cut), were responsible for a majority of the sediment that enters an aquatic system. Road construction causes the stream channel network to increase, because the roads act as tributaries, creating a more efficient sediment delivery system (Castro and Reckendorf 1995). McCashion and Rice (1983) found that logging roads were responsible for 61 percent of the soil volume displaced by erosion in northwestern California.

Road construction and maintenance associated with timber harvest typically increases the amount of sediment delivered to streams through surface erosion, as compared to natural delivery rates. The disturbed areas of the road "prism" include the road subgrade, cut and fill slopes, ditches, berms, turnouts, stream crossings, and any other construction features that may be present (Fitzgerald *et al.* 1998). Roads continue to have adverse general effects to stream communities even when not actively utilized; they continue to contribute high sediment loads until they are stabilized and abandoned (Cederholm and Reid 1987). Roads can rarely be constructed that do have not cause adverse effects to streams (Furniss *et al.* 1991). Roads constructed within riparian areas and parallel to streams typically have pronounced adverse effects to aquatic systems, compared to roads built in other locations.

Reid and Dunne (1984) found that gravel forest roads generated up to 300 tons of sediment/mile/year from surface erosion in the Olympic Mountains of Washington. They found sediment loss was found to be related to traffic intensity and was highest on heavy-use gravel roads compared to unused roads or paved roads. Sediment yield from cutbanks and ditches alongside paved roads was less than 1 percent of that from gravel roads. Heavily used roads were calculated to produce 300 tons of sediment/mile/year over the period of study, compared to lightly used roads with 2.6 tons/mile/year and paved roads with 1.4 tons/mile/year.

Roads accelerate soil erosion rates due to surface erosion and mass soil movement such as slumps and earthflows, debris avalanches, debris flows, and debris torrents. High rates of stream sedimentation result from this increased erosion. Furniss *et al.* (1991) found soil erosion rates were 30 to 300 times higher on forests with roads than undisturbed forest. Roads also altered streamflow rates and volumes, which along with increased sedimentation, resulted in altered stream channel geometry (Furniss *et al.* 1991). Acting as new flowpaths for water, roads increased the channel network over watersheds, increasing the drainage density.

Roads can also degrade fish habitat reducing access to habitat, an indicator of proper functioning condition. Migration barriers such as culverts and temporary dams caused by landslides, are effects on habitat access associated with road use and management. Erosion results in sedimentation of streams and causes declines in spawning habitat when too high a proportion of fine sediment was deposited. Hicks *et al.* (1991) found that salmonid survival rates decreased after logging and road construction as fine sediment levels in streams increased and as important habitat characteristics, including the number of pools and winter cover, decreased. Macroinvertebrates, the primary food source of juvenile fish, also typically decline when large amounts of sediment are added to the stream system (Furniss *et al.* 1991). These effects are likely to arise under the environmental baseline.

The introduction of amounts of sediment substantially in excess of natural levels can have multiple adverse effects on channel conditions and processes resulting in effects on aquatic species survival, the food web, and water quality conditions, such as water temperature and dissolved oxygen (Rhodes *et al.* 1994). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985) but may also limit access to substrate interstices that are important cover during rearing and overwintering of salmonids (see Goetz 1994; Jakober 1995). Shifts in sediment loads set off a complex of channel responses including changes in pool volumes, depth and frequency, and changes in channel morphology (including slope, sinuosity, shape, velocity, flooding regime, and sediment transport) (Rhodes *et al.* 1994; Castro and Reckendorf 1995).

Sedimentation from road building and maintenance without the prescriptions in the HCP would likely be of moderate to long duration and of greater local and systemic effect, depending on geology, slope, road use, and maintenance status. Such sedimentation would adversely effect interstitial spaces for proposed covered aquatic species, including side-channel and backwater habitat for juvenile and adult fish, deep pools for overwintering and migrating adults, egg survival, prey base abundance, and aquatic species feeding activities. Each of these are important habitat elements to the salmonid life histories that occur in the forested environment. In fact, all life history stages of migratory fish species covered under the proposed action, could be adversely affected.

b. Road Management and Remediation under the HCP

The Plan Area contains 1,996 total active road miles (see Table 14 in the HCP). Roads traverse a variety of landscapes and cover approximately 3.7 percent of the land base. Presently, active roads in the Plan Area represent a significant source of delivery of coarse and fine sediments into streams inhabited by aquatic species proposed for coverage. Simpson Timber has not specified expected road densities for land that might be added to the covered lands during the permit term. In conducting this analysis, NMFS assumed that similar road densities exist or would develop on such added land.

Given the sensitivity of salmonids and other aquatic species to increased sediments delivered at critical life stages, areas of road construction or maintenance are likely to adversely affect fish. Depending on the location of road construction (e.g., unstable slopes, riparian areas, etc.) and drainage network in the proposed Plan Area and within those potentially covered lands allowed to be added for coverage per section 10 of the Implementing Agreement, riparian buffers are not expected to entirely mitigate these these effects. Improperly sized and placed culverts would likely continue to be passage barriers that restrict fish movement until they are replaced. The Services expect that within 10 years at least 75 percent of the high priority road remediation projects will be complete; of these projects, fish passage will be one of the highest priorities.

Although road use in the Plan Area would primarily be associated with logging activity period, roads would continue to deliver various amounts of sediment to these streams in excess of natural rates into the future, at least until these roads are permanently abandoned (i.e., stabilized and put to bed). Each affected creek and river contributes to the water quality of a spawning, rearing, migratory, and/or foraging corridor for covered species. These species would likely be adversely affected due to effects to spawning, rearing, migration and foraging behavior, habitat degradation, food supply disturbances, and altered water quality and quantity.

Tree removal associated with road activities would likely result in increased temperature levels within fish-bearing streams, including those potentially or actually occupied by salmonids. Road rights-of-ways are generally kept free of larger vegetation for sight-distance and vehicle/structure clearance, providing long-term stream exposure to sunlight in many locations where roads cross or are near streams.

The provisions of the HCP covering road use and management (HCP section 5.2.4) are summarized in Section II. B and V of this Opinion. As discussed above, increased sedimentation and decreased riparian function (LWD, shade, litter fall, nutrients) are likely effects of road use and management in or near riparian areas. The HCP includes a suite of road-related prescriptions and other conservation measures which will reduce the effects of the existing road system and significantly minimize future effects. Measures to reduce the delivery of sediment and limit the loss of riparian function across the Plan Area include: 1) completing a detailed road inventory program to identify areas of actual and potential sediment delivery and fish passage limitations, 2) a concurrent road remediation program with nearly unlimited funding for the first 10 years to eliminate mass-wasting and sediment delivery from unnecessary or abandoned roads and to correct sediment delivery, mass-wasting potential, road drainage, fish passage limits, and other high priority problems with the permanent road system, 3) avoidance of new road construction near streams or across unstable slopes if at all operationally possible, 4) mitigating the loss of riparian functions from existing or new roads in riparian areas by providing the number and basal area of trees in riparian areas near to the forest practice area that would occur but for the road footprint (cut, fill and running surfaces), 5) construction and reconstruction of roads to meet new Best Management Practices under State Forest Practice Rules that have been designed to lessen impacts to aquatic systems, 6) the conduct of patrols to maintain road drainage systems and monitor delivery of road surface sediments during storm events and periods of high rainfall, particularly along roads subject to wet weather log transportation, and 7) the continued conduct of a comprehensive road maintenance program to ensure that all roads are functioning to design standards.

c. Beneficial Effects of Road Management under the HCP

Each of the HCP's road management provisions will attenuate the effects of roading in the action area. These provisions will reduce the short-term impact of roads on habitats for salmonids, including critical habitats for listed salmonids, through an immediate road remediation program. An important commitment made by Simpson Timber through the HCP is to hydrologically disconnect roads from the aquatic system, extensively reducing the delivery of fine sediments via road ditchlines. The primary biological benefit of the measures taken to reduce fine sediment delivery to streams is to decrease the infiltration of fines to incubating salmonid eggs and alevins and increase their survival to emergence. For Hood Canal summer chum, the incubation period, from August through as late as December, represents their only extended exposure to the freshwater environment and the effects of activities covered under this action. Few areas within the Plan Area boundary currently support Hood Canal summer chum but they have been documented downstream of the Plan Area in tributaries to the Skokomish River and other Hood Canal tributaries. The suite of measures that comprise the roads program will likely improve the quality and distribution of critical incubating habitats for Hood Canal chum.

Under the HCP, Puget Sound chinook will also accrue improved incubating habitats. Like Hood Canal chum, chinook occurrence is mostly downstream of the Plan Area in the Skokomish River and tributaries. However, road measures that address riparian function (i.e. avoiding construction in riparian areas, road footprint mitigation) will benefit the extended freshwater rearing of this species by maintaining riparian areas and their contributions to the quantity and complexity of rearing habitats. Further, the NMFS expects that as existing riparian roads are repaired, redesigned, or abandoned and revegetated there will be a net benefit through increased vegetated riparian area across the Plan Area.

The HCP's road management, remediation, and maintenance measures address processes that affect aquatic and riparian ecological processes that are dominant controls on habitats for covered salmon species. Based on examinations of the literature, knowledge of the Plan Area, and experience and familiarity with forest road management and BMPs being applied in this region and throughout the West, these measures provide a high likelihood of success. With monitoring and overall implementation of the Adaptive Management program the Services expect that road and other sediment-related prescriptions and conservation measures can be adjusted as needed over time to maintain and recover habitats for all salmon species in the Plan Area.

d. Summary

In summary, the effects of roads are predominantly changes in substrate size and distribution through sediment delivery and routing in stream channels and reductions in riparian functions from roads that cross or parallel streams. HCP measures to avoid, minimize, and mitigate the effects of roads on covered species are summarized in Section V. B. of this Opinion, described above, and presented in detail in the HCP and the Services' FEIS (Sections 5, 6 and Appendix C in STC July 2000; NMFS and USFWS July 2000, respectively). Conservation measures to avoid, minimize and mitigate potential effects from roads are likely to attenuate effects on, and increase the value of, critical habitats for Puget Sound chinook and Hood Canal chum in or downstream of the Plan Area. These same benefits can reasonably be expected for other covered salmon species as well. Overall, management prescriptions and conservation measures for road construction, remediation, and maintenance are expected to substantially contribute to the maintenance and recovery of properly functioning habitats for all covered salmon species in the Action Area.

3. Log Transportation

Log haul on unpaved roads will generate sediments that can be directly routed to stream channels. The extent and timing of such sediment delivery can affect any salmon species in the incubation stage. The general effects of this activity are described in the discussion of sedimentation processes in sections 1 and 2 (Timber Harvest and Road Construction, Maintenance, and Decommissioning), above. The effects of this covered activity would be similarly avoided, reduced, or minimized as would the effects of timber harvest and road use and management. Furthermore, rail transportation within the Plan Area would contribute to overall level of effects on covered species, and which are minimized and mitigated as specified in the HCP. Effects associated with log transportation over lands that added for coverage per section 10 of the Implementing Agreement, would be minimized and mitigated by imposing the same HCP measures applied to initially covered lands, which are summarily described in section 1., above.

4. Site Preparation and Slash Abatement

Coarse woody debris is recognized as an important component of northwest forest ecosystems, and is linked to biodiversity and ecosystem processes (Arsenault 1999). Coarse woody debris features are high centers of biological interaction and energy exchange (Arsenault 1999). Because most of the Plan Area has been cut previously and consists of stands less than 50 years old (and would be harvested during the proposed ITP period before large trees could develop), most slash and downed wood potentially left in site preparation and slash abatement areas (post-harvest) would be small to moderate sized (versus large logs).

As proposed, larger downed wood components are expected to be retained in portions of the Plan Area in at least three ways (see Description of Proposed Action): the prohibited salvage of any residual old-growth downed wood or stumps; the retention of at least two downed logs for each acre harvested throughout the Plan Area; partial or full conservation/protection of at least 16.3 percent of the Plan Area, much of which is forested and would contribute woody debris and logs. These measures will provide downed wood for riparian and near-riparian forests that provide dominant controls on habitats for all salmon species.

5. Silvicultural Thinning

The Simpson Timber Company intends to conduct commercial forestry activities across much of the Plan Area. Thinning of commercial and pre-commercial trees is a common silvicultural treatment to reduce competition and increase growth rates of conifer and other economically valuable tree species. Thinning would primarily occur in forest stands upland of riparian conservation reserves, experimentally in some riparian conservation areas, and in some forested wetlands of the Plan Area. The actual methods of thinning are expected to vary from hand treatments and leaving cut trees to decompose on the forest floor to mechanized removal and haul of commercially valuable species and sizes. The effects of mechanized thinning and log haul are essentially the same as those analyzed under Timber Harvest in Section VI. A. 1. of this Opinion and are not examined further. Wetlands potentially subject to thinning are forested wetlands not expected to be providing habitats for species regulated by the NMFS. Effects to forested wetlands and the species they support are analyzed in a companion Biological Opinion by the USFWS (2000) but are described in Section II.of this Opinion in the general context of watershed-scale groundwater hydrology. Riverine-associated wetlands and their value as habitat for winter and summer rearing salmonids are conserved through inclusion of unharvested channel migration zones and overall riparian conservation measures described in Section II of this Opinion.

There would be limited experimental thinning of as much as 1,000 acres of riparian reserves over the Plan Area in the first ten years of the Plan. Selection of these areas would be weighted by the total length of stream in each channel class, thus concentrated in higher elevation riparian reserves along the small stream channels that comprise the vast majority of the stream mileage in the Plan Area (see Table 3). For example, there are approximately 200 miles of CUP-C1 channels (14.3% of the all streams) in the Plan Area. Experimental thinning in these riparian reserves would total approximately 143 acres over 10 years. These experimental treatments are guided by the primary habitat goal of the Simpson HCP: *to conserve and develop intact, ecologically connected and naturally functioning aquatic ecosystems* (Section 4.4, STC July 2000). The NMFS is thus reasonably assured that experimental thinnings will be conducted to develop riparian forest stand structure and growth that accelerates achievement of properly functioning habitat conditions for covered species. NMFS is also familiar with riparian conditions in the Plan Area and expects that most experimental treatments will focus on hardwood dominant or mixed hardwood/conifer stands to release or establish conifer species in recognition of the potential natural vegetation at those sites. After the first ten years of the permit period, up to 2,800 acres of additional thinning may occur throughout the RCRs for the duration of the Plan period, if such treatments have been shown to achieve the primary aquatic habitat goal of the Plan.

In the short-term, however, even experimental thinning of riparian areas can affect aquatic habitats through loss of litter and nutrients, coarse woody debris to the riparian forest floor, and decreased LWD recruitment to streams. Snag tree may be removed to meet safety requirements that otherwise might recruit to aquatic habitats. Thinning also may disturb soils in riparian areas through the use of ground based equipment of log yarding that causes sediments to be delivered to streams. In general, the effects of mechanized thinning and tree removal are the same as those analyzed under Timber Harvest in Section VI. A. 1. of this Opinion

Overall, experimental thinning of riparian reserves may cause limited impacts to riparian function at the stream reach scale but is not expected to result in adverse modification or destruction of critical habitats or impede the achievement of properly functioning riparian or instream habitat conditions. What short-term impacts may occur are spread over time, over a broad area, and focused in small stream channels, likely at the limits of occupied habitats for covered salmon species. Guided by Simpson Timber Company's aquatic goal for the Plan Area - *to conserve and develop intact, ecologically connected and naturally functioning aquatic ecosystems* (Section 4.4, STC July 2000) - the NMFS expects a net benefit to habitats critical for the survival and recovery of listed and unlisted species in or downstream of the Plan Area. Should experimental treatments not be shown to be beneficial to riparian processes in keeping with this goal, the activity can be terminated, thus avoiding any further effects for the remainder of the Plan term.

6. Fire Suppression

Fire suppression or prevention activities include fire fighting techniques that can cause ground disturbance and riparian snag removal. Effects of these activities on covered species include increased sediment delivery to aquatic systems resulting from ground disturbance associated with fire fighting or prevention, and disturbance to covered species occupying habitat adjacent to suppression activities. These effects are expected to short-lived and quickly remedied through revegetation treatments, slope stabilization, and other post-fire activities commonly employed on forestlands following fires.

7. Stream Restoration

Stream restoration is not expected to be a significant activity under the Simpson HCP, nor are the local improvements to salmon habitats possible through restoration considered to be a significant contribution to properly functioning conditions across the Plan Area. The emphasis of the Simpson HCP is the provision of those self-sustaining processes (e.g. properly functioning riparian forests) that maintain and create habitats. Stream restoration is prescribed only as an experimental pilot project (Section 5.2.7(b), STC July 2000) to be established within 5 years of issuance of the ITP. The purpose of this pilot project is to investigate operationally practical ways to add wood to streams for the purpose of increasing the complexity of fish habitats. These habitats may be designated critical habitats for listed salmon or other covered salmon species.

Site-level adverse effects would include increased sediment delivery to the treatment reach from ground-based equipment used near and in stream channels. Some temporary disturbance of rearing salmon species can be expected in the treatment reach during project implementation. Pink and chum salmon are not expected to be susceptible to any disturbance caused by stream restoration treatments because of their rarity and/or limited freshwater rearing. Disruption of incubating eggs or alevins is expected to be avoided by timing construction activities outside the incubation period for any covered salmon species. Overall, adverse effects on critical habitats or properly functioning conditions for covered species are expected to be minimal, short-lived, localized, and offset by the increased habitat complexity and stability resulting from the restoration treatments.

8. Research and Monitoring

The Simpson HCP calls for an extensive, long-term research and monitoring effort to test assumptions about conservation measures and management prescriptions and to monitor progress toward various objectives (e.g. TMDL water quality loading for sediment and water temperature.) A detailed description of the Research and Monitoring effort is provided in Section 9 of the HCP (STC July 2000). An example of the quality and value of Simpson's research and monitoring, and a significant contribution to the development of riparian management prescriptions in the HCP, is described in Riparian Monitoring Studies in Appendix E of the HCP (STC July 2000). Electrofishing activities would be used as part of research and monitoring in under the HCP. Sampling techniques such as those involved in electrofishing or amphibian sampling techniques can be injurious or fatal to fish. Reported fish injuries associated with electrofishing include spinal hemorrhage, fractured vertebra, spinal misalignment, and separated spinal column (Dalbey *et al.* 1996; Thompson *et al.* 1997a, b; Kocovsky *et al.* 1997). Differences in injury and mortality rates were reportedly because of size and/or age of the fish (Habera *et al.* 1996; Thompson *et al.* 1997a). Injury from electrofishing applies mostly to adult fish, and not juveniles for which stress can be the main problem when electrofishing (Nielsen, Jennifer L., "Electrofishing California's Endangered Fish Populations," Fisheries, December 1998, Volume 23, Number 12). Fish injury rates vary due to voltage level used, experience and skill of samplers, duration of capture sequence (i.e. the amount of time taken to complete electrofishing within a sample area), and frequency of sampling through time (years) (Kocovsky *et al.* 1997). Sublethal effects are not always externally evident in electrofished populations, and biologists appear to greatly underestimate spinal injuries from external examinations alone Dalbey *et al.* (1966) indicated that only 2 percent of the captive wild rainbow trout they surveyed had externally visible deformities, but X-ray analysis used to quantify sublethal injuries after nearly one year in captivity indicated 37 percent of the population that had actually been injured.

Long-term effects from electrofishing would likely include differences in growth rate and/or body condition in individual fish during variable periods of time after electrofishing (Gatz *et al.* 1986; Taube 1992; Dwyer and White 1995). Electrofishing would be used for last-fish distribution monitoring only, which does not entail multiple passes through the same stream reach. A single pass will limits exposure of individual fishes to harmful effects of the electric field and is expected to significantly minimize or avoid mortality. In addition, all electrofishing would be done according to Services' approved protocols, which minimizes risk to fish and may or may not reduce risks to amphibians as well. The approved protocols minimize risk to fish by limiting voltages, amperages, sampling period and season. Instream activities, including electrofishing or the disturbance of humans walking across the streambed, could also result in mortality of eggs, alevins, or juvenile coho salmon or steelhead, the species that typically penetrate furthest upstream and may possibly be present when electrofishing is conducted to determine fish presence. Other effects could include temporary displacement of juvenile salmonids as a result of substrate disturbing monitoring techniques used for amphibians and other aquatic or semi-aquatic species. The methods, potential disturbance, and effects associated monitoring of the Headwater Species Association (torrent salamander, tailed frog, Cope's giant salamander, and Western redback salamander) and Steep Tributary Species Association (cutthroat trout, shorthead sculpin, and Van Dyke's salamander) are described in Appendix A of the HCP (STC) and analyzed in the USFWS' companion Biological Opinion for the Simpson ITP (USFWS October 2000).

Considering the range of effects from activities covered under the Simpson HCP analyzed in this Opinion, particularly those from timber harvest and road management, the effects of research and monitoring are quite limited and not expected to be a significant adverse effect on critical habitats or to impede achievement of properly functioning conditions. The benefit of research and monitoring is to ensure that conservation measures and management prescriptions are effectively achieving their goals and conserving and increasing habitat quality and quantity across the Plan Area over time. Coverage of electrofishing as an activity has the effect of providing a simple field method to validate the need to increase or extend riparian conservation reserves further upstream along small channels, thereby benefitting water quality and contributing to properly functioning conditions in salmon habitats downstream. Take of threatened Puget Sound chinook or Hood Canal summer salmon is likely avoided by virtue of electrofishing occurring well upstream of their habitats and being seasonally and operationally limited by Services' protocols.

9. Minor Forest Products Management

Minor forest products harvested under the HCP include, among others: firewood, salal, ferns, and mushrooms. The estimated annual range of acres affected are: firewood (4,000 to 5,000 acres per year); floral brush (50,000 to 60,000 acres per year; mushrooms (2,000 to 7,000 acres per year) and an unknown acreage associated with ferns. The proposed specialized forest product activity which is most likely to affect the species covered under the HCP is firewood collection, and the effects from such activity include habitat modification and disturbance. Salvaging standing dead trees or logs removes coarse woody debris that contributes to the soil-building processes in riparian areas and provides germination sites for desirable riparian tree species.

The use of vehicles in and near streams during special forest product collections could alter riparian processes and may disturb incubating or spawning salmon.

10. Vertebrate Control

Flat-tailed beaver (*Castor canadensis*) would be controlled by trapping or relocation, through a specific condition of the ITP that limits take resulting from appropriate means to control flat-tailed beaver associated with roads where activities of such beavers pose a reasonably foreseeable risk to the integrity of one or more roads. Integrity of the road fills would be based on the potential for the erosion of the road surfaces, plugging of culverts and failure of road fills. In this case some loss of coho salmon habitat could occur, in addition to the loss of beneficial sediment storage and routing effects created by beaver activities across the landscape. On the other hand, the loss of these beneficial effects is balanced by the expected reduction in the loss of road fills that would otherwise increase sedimentation of aquatic systems. This would serve to maintain channel integrity and spawning, incubation, rearing and holding habitats for all salmon species over time.

B. Determination of Post Termination Mitigation

The terms and processes for determining any additional mitigation owed by Simpson Timber Company for early abandonment, revocation or suspension of the ITP are described in Section 12 of the Implementing Agreement (STC July 2000). The primary feature of the Post Termination Mitigation agreement is a linkage to accomplishment of top priority road remediation projects. Essentially, prior to year 10 following ITP issuance, mitigation needs would be determined on a unit basis, proportional to the accomplishment of road remediation projects.

C. Cumulative Effects

Cumulative effects are those effects caused by non-Federal projects and activities unrelated to the action under consideration. The most relevant potential cumulative effects are from forestland management on adjacent non-Federal land and problems associated with fish passage to and from the Plan Area. These effects include the future actions of State, tribal, local, or private agencies or individuals that are reasonably certain to occur in the action area. Future Federal actions unrelated to the proposed action are beyond the scope of this analysis and will be analyzed in future consultations pursuant to section 7 of the ESA.

It is anticipated that other non-Federal activities will continue at the same level as in the past. Since issuance of the ITP and implementation of this HCP, other complimentary improvements in forest land management within and adjacent to the Planning Area have been and will be realized. These improvements include the passage of legislation by the Washington Legislature (ESHB 2091, June 1999) directing the revision of Washington Forest Practice Rules to contribute to the recovery of endangered and threatened salmonids. Forest practices under the revised state rules will benefit anadromous salmonids through improved management of riparian ecosystems, instream habitats, water quality, reduced delivery of coarse and fine sediments to aquatic systems, and overall improved watershed conditions on State-owned and private lands within and adjacent to the action area.

As with other indirect effects, these cumulative effects are synergistic and unquantifiable but are considered by the NMFS to complement the conservation and mitigation measures that Simpson Timber is implementing through the HCP and IA.

D. Conclusion

The preceding analysis examined the covered activities, the species that may be affected, the processes by which there may be effects, and the consequences thereof on the overall productivity of salmon habitats across the Plan Area. The NMFS has examined general information in the species' Status Reviews (Table 1.), specific information in the Services's FEIS, the Simpson HCP and finds these and other sources of information to be sufficient with which to conduct this analysis. Based on the best available scientific information, NMFS concludes that issuance of the proposed ITP is not likely to jeopardize the continued existence of threatened Puget Sound chinook, threatened Hood Canal summer chum, candidate coho salmon ESUs, or unlisted populations of anadromous fishes that occur in the Plan Area. Furthermore, based on the best available scientific information, NMFS concludes that issuance of the proposed ITP is not likely to result in the destruction or adverse modification of critical habitat of any of the identified covered species.

VII. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR Section 222.102). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with this Incidental Take Statement.

Take of threatened Puget Sound chinook and Hood Canal summer chum salmon has been prohibited by a final 4(d) rule that becomes effective on January 9, 2000 (65 Fed. Reg. 42422, July 10, 2000). The Incidental Take Permit proposed to be issued by the NMFS provides authorization to take listed species under the terms of the HCP, IA, and the Permit itself.

The Simpson Timber Company HCP (STC July 2000) and its associated documents clearly identify anticipated impacts to affected species likely to result from the proposed taking and the measures that are necessary and appropriate to minimize those impacts. Covered activities with a high likelihood of causing injury or death to individual anadromous salmonids include sediments introduced to streams from routine watershed management, sediments delivered to streams through catastrophic events such as slope failures that are directly or indirectly related to forest management operations, road construction and repair, and cable- and ground-based movement of logs near and through riparian areas. For example, incubating eggs downstream of road repair sites could be smothered by careless operations where sediment containment is ineffective or the ground-disturbing activities occur during extreme wet conditions. Fish could be dewatered or smothered in tributary streams next to forest road repair. Incubating eggs could be disturbed by incidental or careless movement of cables or logs through riparian yarding corridors, or by modifying vegetation to create the yarding corridors themselves. An example of effects beyond the egg stage might be increased avian or fish predation of rearing juvenile salmon that have been temporarily or chronically displaced by changes in preferred or useable habitats (loss of pool complexity, depth, frequency or distribution) from sediment input and storage. The frequency, location and duration of covered activities resulting in levels of impacts severe enough to harm fish are too speculative to allow NMFS to estimate possible numbers of fish taken under this HCP.

A. Incidental Take of Covered Species

1. Puget Sound Chinook - Listed Species

The NMFS anticipates that an undetermined number of Puget Sound chinook salmon may be taken as a result of full implementation of the proposed action and associated level of protection over the permit term and possible extensions. The incidental take of this species is expected to be in the form of harm, harassment, kill, and injury, resulting from activities covered under the HCP. As analyzed in this opinion, the NMFS has determined that this extent of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Harm may occur due to habitat modifications resulting from watershed management and road management activities.

Harassment may occur when instream activities are conducted where fish are present, such as the creation and use of log yarding corridors through riparian zones, road maintenance and improvements, and monitoring activities.

Kill may occur due to the use of equipment in streams during construction and maintenance of forest roads and catastrophic inputs of coarse and fine sediments through management-related mass-wasting.

Injury may occur due to instream activities where fish are present, such as construction and maintenance and improvements of forest roads, the conduct of forest management activities in and near fish-bearing streams, and monitoring activities.

2. Hood Canal Summer Chum Salmon - Listed Species

The NMFS anticipates that an undetermined number of Hood Canal summer chum salmon may be taken as a result of full implementation of the proposed action and associated level of protection over the permit term and possible extensions. The incidental take of this species is expected to be in the form of harm, harassment, kill, and injury, resulting from activities covered under the HCP. As analyzed in this opinion, the NMFS has determined that this extent of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Harm may occur due to habitat modifications resulting from watershed management and road management activities.

Harassment may occur when instream activities are conducted where fish are present, such as the creation and use of log yarding corridors through riparian zones, road maintenance and improvements, and monitoring activities.

Kill may occur due to the use of equipment in streams during construction and maintenance of forest roads and catastrophic inputs of coarse and fine sediments through management-related mass-wasting.

Injury may occur due to instream activities where fish are present, such as construction and maintenance and improvements of forest roads, the conduct of forest management activities in and near fish-bearing streams, and monitoring activities.

3. Chum Salmon - Unlisted Species

The NMFS anticipates that an undetermined number of chum salmon may be taken as a result of full implementation of the proposed action and associated level of protection over the permit term and possible extensions. The incidental take of this species is expected to be in the form of harm, harassment, kill, and injury, resulting from activities covered under the HCP. As analyzed in this opinion, the NMFS has determined that this extent of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Harm may occur due to habitat modifications resulting from watershed management and road management activities.

Harassment may occur when instream activities are conducted where fish are present, such as the creation and use of log yarding corridors through riparian zones, road maintenance and improvements, and monitoring activities.

Kill may occur due to the use of equipment in streams during construction and maintenance of forest roads and catastrophic inputs of coarse and fine sediments through management-related mass-wasting.

Injury may occur due to instream activities where fish are present, such as construction and maintenance and improvements of forest roads, the conduct of forest management activities in and near fish-bearing streams, and monitoring activities.

4. Coho Salmon - Unlisted Species

The NMFS anticipates that an undetermined number of coho salmon may be taken as a result of full implementation of the proposed action and associated level of protection over the permit term and possible extensions. The incidental take of this species is expected to be in the form of harm, harassment, kill, and injury, resulting from activities covered under the HCP. As analyzed in this opinion, the NMFS has determined that this extent of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Harm may occur due to habitat modifications resulting from watershed management and road management activities.

Harassment may occur when instream activities are conducted where fish are present, such as the creation and use of log yarding corridors through riparian zones, road maintenance and improvements, and monitoring activities.

Kill may occur due to the use of equipment in streams during construction and maintenance of forest roads and catastrophic inputs of coarse and fine sediments through management-related mass-wasting.

Injury may occur due to instream activities where fish are present, such as construction and maintenance and improvements of forest roads, the conduct of forest management activities in and near fish-bearing streams, and monitoring activities.

5. Steelhead - Unlisted Species

The NMFS anticipates that an undetermined number of steelhead may be taken as a result of full implementation of the proposed action and associated level of protection over the permit term and possible extensions. The incidental take of this species is expected to be in the form of harm, harassment, kill, and injury, resulting from activities covered under the HCP. As analyzed in this opinion, the NMFS has determined that this extent of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Harm may occur due to habitat modifications resulting from watershed management and road management activities.

Harassment may occur when instream activities are conducted where fish are present, such as the creation and use of log yarding corridors through riparian zones, road maintenance and improvements, and monitoring activities.

Kill may occur due to the use of equipment in streams during construction and maintenance of forest roads and catastrophic inputs of coarse and fine sediments through management-related mass-wasting.

Injury may occur due to instream activities where fish are present, such as construction and maintenance and improvements of forest roads, the conduct of forest management activities in and near fish-bearing streams, and monitoring activities.

6. Pink Salmon - Unlisted Species

The NMFS anticipates that an undetermined number of pink salmon may be taken as a result of full implementation of the proposed action and associated level of protection over the permit term and possible extensions. The incidental take of this species is expected to be in the form of harm, harassment, kill, and injury, resulting from activities covered under the HCP. As analyzed in this opinion, the NMFS has determined that this extent of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Harm may occur due to habitat modifications resulting from watershed management and road management activities.

Harassment may occur when instream activities are conducted where fish are present, such as the creation and use of log yarding corridors through riparian zones, road maintenance and improvements, and monitoring activities.

Kill may occur due to the use of equipment in streams during construction and maintenance of forest roads and catastrophic inputs of coarse and fine sediments through management-related mass-wasting.

Injury may occur due to instream activities where fish are present, such as construction and maintenance and improvements of forest roads, the conduct of forest management activities in and near fish-bearing streams, and monitoring activities.

B. Reasonable and Prudent Measures

All conservation measures described in the final HCP (STC July 2000), together with the terms and conditions described in the associated Implementation Agreement and the section 10(a)(1)(B) permit issued with respect to the HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement. Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the ESA to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the proposed HCP, associated reporting requirements, and provisions for disposition of dead or injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) permit.

VIII. REINITIATION OF CONSULTATION

This concludes formal consultation on these actions in accordance with 50 CFR 402.14(b)(1). Reinitiation of consultation is required: (1) If the action is modified in a way that causes an effect on the listed species that was not previously considered in the biological assessment and this biological opinion; (2) new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered; or (3) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

IX. SECTION 10 (a)(2)(B) FINDINGS

A. Permit Issuance Considerations

Although only two of the nine anadromous salmonids addressed in the HCP are listed under the ESA at this time, this document is intended to provide Simpson Timber Company assurances that they will receive an Incidental Take Permit if and when such unlisted species are subsequently listed under the ESA, subject to the "unforeseen circumstances" clause in the IA. In order to issue an incidental take permit under the ESA Section 10(a)(1)(b) and 50 C.F.R. § 222.307 the NMFS must consider the following:

1. The status of the affected species or stocks. The status of anadromous salmonids potentially affected by the HCP has been considered above (see Section III of the Biological Opinion). The environmental baseline for anadromous fish and their habitats (Section IV) was also considered.

2. The potential severity of direct, indirect and cumulative impacts on anadromous salmonids and their habitats as a result of the proposed activity. The impacts of the HCP were examined in detail in this analysis (see Section VI of the Biological Opinion).

3. The availability of effective monitoring techniques. Monitoring of the implementation of the HCP and the effectiveness of the HCP prescriptions are a critical feature of this HCP. Monitoring reports will be completed and submitted to the NMFS and the USFWS according to the schedule described in section 10 of the HCP. The frequency and period of monitoring varies by plan element with compliance monitoring of key items extending throughout the entire 50-year plan term.

4. The use of the best available technology for minimizing and mitigating impacts. The prescriptions established in this HCP represent the most recent developments in science and technology in minimizing and mitigating impacts to riparian and aquatic habitats, from road management to silvicultural treatment of riparian forests to preserve and enhance ecological functions. Further, the adaptive management component of this HCP assures new science and technology will continue to be employed in the HCP as it is developed.

5. The views of the public, scientists and other interested parties knowledgeable of the species or stocks or other matters related to the application. Over the past few years, the Applicant has hosted many tours of the Plan Area, meetings with stakeholders, and kept interested citizens informed through public meetings related to the HCP and pursuit of other landscape plans and arrangements with the State of Washington which are based on the HCP. In order to get scientific involvement in development of the HCP, the Applicant held meetings on specific issues, including a workshop specifically on the channel classification and riparian management strategies with recognized regional experts.

The Services formally initiated an environmental review of the project through a Notice of Intent to prepare an Environmental Impact Statement (EIS) in the Federal Register on February 9, 1999 (64 Fed. Reg. 6325). This notice also announced a 30-day public scoping period, during which other agencies, tribes, and the public were invited to provide comments and suggestions regarding issues and alternatives to be included in the Statement. A draft EIS was subsequently produced and made available for a 62-day public review period on October 22, 1999 (64 Fed. Reg. 57630). The comment period was extended for 18 days to January 14, 2000 (65 Fed. Reg. 761), in direct response to requests from the public. This resulted in a total comment period duration of 80 days. Nineteen comment letters were received by the Services: 4 from government agencies; 5 from tribal representative organizations; 7 from public interest groups; and 3 from individual citizens. Many of the comments and suggestions were incorporated into the proposed HCP and FEIS. Appendix D of the Final EIS contains a summary of those comments, the Service's responses, and a summary of changes made to the HCP and EIS. The Final EIS was noticed in the Federal Register on July 20, 2000 (65 Fed. Reg. 45038). Three public interest groups submitted comment letters regarding the FEIS. Summaries and responses to those comments are contained in Appendix B of this document.

The public process had substantial influence on the final outcome of this proposal. A number of substantive changes were made in the proposed HCP and DEIS as a direct result of public comments. These changes were incorporated into the final HCP and EIS. All comment letters received by the Services regarding the final documents acknowledged positive conservation changes.

Another factor the Services considered in making the decision was consistency with the Federal Trust responsibility to Native American

Tribes. This Trust responsibility imposes a duty on Federal agencies to protect Trust assets for Tribes. Through the development and comment phases of drafts of the HCP, the Services have held numerous meetings with affected tribal governments or their technical staffs to inform, discuss, and represent their interests in these matters. The Services have concluded that the proposed HCP is consistent with this Trust responsibility.

B. Permit Issuance Findings

Having considered the above, the NMFS makes the following findings under Section 10(a)(2)(b) of the ESA with regard to the adequacy of the HCP meeting the statutory and regulatory requirements for an Incidental Take Permit under Section 10(a)(1)(B) of the ESA and 50 C.F.R. § 222.307:

1. The taking of listed species will be incidental. The NMFS anticipates that the proposed action would likely result in incidental take of threatened Puget Sound chinook and threatened Hood Canal summer-run chum salmon, and other currently unlisted species of anadromous salmonids. Activities that will occur in the HCP area that may result in take may include "harm" through adverse changes in essential habitat features such as elevated wood loading or short-term passage limitations in the channel from premature blow-down of managed riparian forests, inadvertent damage to channels or streambanks from log removal or tree felling, and additional sediment inputs due to landslides and road use throughout the planning area. Also, take may occur via the "harass, kill, or injury" definition as well, by frightening or disturbing spawning fish during road construction or crossings or monitoring and research activities. Some instances of incidental take will likely occur despite the conservation measures in the HCP. These types of take are speculative, not quantifiable, and would be limited in extent to a fraction of the action area.

2. The Simpson Timber Company will, to the maximum extent practicable, minimize and mitigate the impacts of taking anadromous salmonids associated with commercial forest management and related activities. Measures in this HCP minimize and mitigate for any take that may occur, through assurance of timely remediation of road drainage, design, and sediment effects; identification of unstable slopes and avoidance of harvest thereon; and by the retention and management of riparian forests throughout the HCP area that assure attainment of properly functioning riparian habitats for fish-bearing streams during the plan term. Also, Simpson Timber Company will monitor and conduct research to test assumptions and to determine effectiveness of HCP prescriptions.

The HCP and IA provide specific conservation measures to monitor, minimize, and mitigate the impact of take of Puget Sound chinook and Hood Canal summer chum salmon under the permit. One measure of "maximum extent practicable" is to look at how the road management and remediation programs are planned and funded. Within five years all roads will be inventoried and assessed for risk of failure and delivery of sediments to aquatic systems. Even while this inventory is being completed, remedial work will be undertaken with essentially an unlimited budget for repair work for the first 10 years following issuance of the permit. After year 10, most of the priority work is expected to be complete and the funding will decrease. In addition, existing or new roads that are unavoidably maintained or constructed within riparian areas will be mitigated through provision of trees that would be present but for the road footprint.

Another measure of "maximum extent practicable" looks at the sufficiency of the HCP for ESA listed species and their requisite habitats. The riparian conservation strategy has been designed to meet the functional requirements of the stream and riparian forest processes through extensive, credible research and classification of stream channels and the geomorphic settings in which they occur. The result is a set of prescriptions specific to each of 49 separate channel classes that provide riparian reserves and management areas that vary in width and extent as needed to conserve and restore ecological functions by recognizing dominant features and processes unique to each setting. As described above, and in the parallel Biological Opinion by the USFWS (USFWS 2000), the proposed action of issuing ITPs would have a high likelihood of providing for the survival and recovery of all ESA listed species.

3. The NMFS has received the necessary assurance that the plan will be funded and implemented. The suite of mitigation, minimization, and adaptive management measures have assured funding commensurate with the effort and operational costs specific to each element. Signing of the IA by the Simpson Timber Company assures that the HCP will be implemented. Also, the HCP and IA commit the Company to adequately fund implementation of the HCP.

4. Based upon the best available scientific information, the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild. Conservation measures identified in the plan will increase the quality and quantity of spawning and rearing habitat and result in a benefit to anadromous salmonid species. The Act's legislative history establishes the intent of Congress that this issuance criteria be based on a finding of "not likely to jeopardize" under section 7(a)(2) [see 50 C.F.R. '402.02]. This is the identical standard to Section 10(a)(2)(B). The conclusions regarding jeopardy for listed ESUs and for all other unlisted anadromous salmonid are found in Section VI. F. CONCLUSIONS, in this Opinion. In summary, the NMFS has considered the status of the species, the environmental baseline and the effects of the proposed action, and any indirect and cumulative effects, to conclude that issuance of the Incidental Take Permit for Puget Sound chinook and Hood Canal summer chum salmon to the Simpson Timber Company for anadromous fish species, would likely not jeopardize the continued existence of any of the anadromous salmonids addressed in the HCP.

5. The Simpson HCP has been developed to assure that other measures, as required by the NMFS have been met. The HCP and IA, together with the assurances and additional technical

rigor provided through the related TMDL Agreement, incorporate all elements determined by the NMFS to be necessary for approval of the HCP and issuance of the permit.

C. Conclusion

Based on these findings, it is determined that the Applicant's HCP meets the statutory and regulatory requirements for an Incidental Take Permit under Section 10(a)(1)(B) of the ESA and 50 C.F.R. § 222.307.

X. ESSENTIAL FISH HABITAT CONSULTATION

A. Background

The objective of the Essential Fish Habitat (EFH) consultation is to determine whether the proposed action may adversely affect designated EFH for relevant species, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse impacts to EFH resulting from the proposed action.

B. Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires the inclusion of EFH descriptions in Federal fishery management plans. In addition, the MSA requires Federal agencies to consult with NMFS on activities that may adversely affect EFH.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting the definition of essential fish habitat: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and ``spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50CFR600.110).

Section 305(b) of the MSA (16 U.S.C. 1855(b)) requires that:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;
- NMFS shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH;
- Federal agencies shall within 30 days after receiving conservation recommendations from NMFS provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the

case of a response that is inconsistent with the conservation recommendations of NMFS, the Federal agency shall explain its reasons for not following the recommendations.

The MSA requires consultation for all actions that may adversely affect EFH, and does not distinguish between actions within EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by Federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of its location.

C. Identification of Essential Fish Habitat

The Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Pacific salmon: chinook (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*)(PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the impacts to these species' EFH from the proposed action is based on this information.

D. Proposed Actions

The proposed actions are detailed above in Section II.B. as the issuance of an Incidental Take Permit (ITP) under Section 10 of the ESA for the implementation of a habitat conservation plan (HCP) and its associated Implementing Agreement by the Simpson Timber Company. The HCP is incorporated herein by reference (STC July 2000). The action area is described above in Section II.D. as 261,575 acres of commercial timberlands owned by the Simpson Timber Company in western Washington State, lands potentially added for ITP coverage (per Section 10.0 and Exhibit A of the Implementing Agreement, and Figure 2 of the HCP), and surrounding lands potentially indirectly affected by the action. These areas have been designated as EFH for chinook and coho and Puget Sound pink salmon.

E. Effects of the Proposed Actions

As analyzed above in Section VI, these activities may result in detrimental short- and long-term impacts to a variety of habitat parameters. The Simpson Timber Company HCP (STC July 2000) and its associated documents clearly identify anticipated impacts to affected species likely to result from the proposed activities and the measures that are necessary and appropriate to minimize those impacts. These effects include delivery of sediments to streams through routine watershed management and through catastrophic events such as slope failures that are directly or indirectly related to forest management operations, road construction and repair, and cable- and ground-based movement of logs near and through riparian areas.

F. Conclusion

The NMFS believes that the proposed action may adversely affect designated EFH for chinook and coho salmon.

G. EFH Conservation Recommendations

The Reasonable and Prudent Measures and the Terms and Conditions outlined above in Section VII. B. are applicable to designated groundfish, coastal pelagic, and Pacific salmon EFH. Therefore, NMFS recommends that they be adopted as EFH conservation measures. Should these measures be adopted, the potential adverse impacts to EFH will be minimized.

H. Statutory Response Requirements

Please note that the Magnuson-Stevens Act (§305(b)) requires the Federal agency to provide a written response to NMFS' EFH conservation recommendations within 30 days of its receipt of this letter. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity. If the response is inconsistent with NMFS' conservation recommendations, the reasons for not implementing them must be included.

I. Consultation Renewal

The NMFS must reinitiate EFH consultation if the actions described in this consultation are substantially revised or new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920).

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Section 7(a)(2) of the ESA requires biological opinions to be based on the best scientific and commercial data available. This section identifies the data and references used in developing this Opinion.

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Appendix to NMFS Section 7 Consultation WSB 99-593

The Habitat Approach

Implementation of Section 7 of the Endangered Species Act for

Actions Affecting the Habitat of Pacific Anadromous Salmonids

Prepared by the National Marine Fisheries Service

Northwest Region

Habitat Conservation and Protected Resources Divisions

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I. Purpose

This document describes the analytic process and principles that the National Marine Fisheries Service (NMFS) Northwest Region (NWR) applies when conducting ESA § 7 consultations on actions affecting freshwater salmon[2] habitat.

II. Background

Section 7 of the Endangered Species Act[3] (ESA) requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of their critical habitat.[4] Federal agencies must consult with National Marine Fisheries Service (NMFS) regarding the effects of their actions on certain listed species.[5] The NMFS evaluates the effects of proposed Federal actions on listed salmon by applying the standards of § 7(a)(2) of the ESA as interpreted through joint NMFS and U.S. Fish and Wildlife Service (FWS) regulations and policies.[6] When NMFS issues a biological opinion, it uses the best scientific and commercial data available to determine whether a proposed Federal action is likely to (1) jeopardize the continued existence of a listed species, or (2) destroy or adversely modify the designated critical habitat of a listed species.[7]

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[2] For purposes of brevity and clarity, this document will use the word "salmon" to mean all those anadromous salmonid fishes occurring in, and native to, Pacific Ocean drainages of the United States – including anadromous forms of cutthroat and steelhead trouts, and not including salmonids occurring in Atlantic Ocean and Great Lakes drainages.

[3] 16 USC §§ 1531 *et seq.*

[4] 16 USC § 1536(a)(2) (1988).

[5] A 1974 Memorandum of Understanding between NMFS and FWS establishes that NMFS retains ESA jurisdiction over fish species that spend a majority of their lives in the marine environment, including salmon. *See* Memorandum of Understanding Between the U.S. Fish and Wildlife Service, United States Department of Interior, and the National Oceanic and Atmospheric Administration, United States Department of Commerce, Regarding Jurisdictional Responsibilities and Listing Procedures under the Endangered Species Act of 1973 (1974).

[6] *See* U.S. Fish and Wildlife Service and National Marine Fisheries Service., *Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.* U.S. Government Printing Office, Washington, D.C. (1998).

[7] 16 USC § 1536(a)(2) (1988).

The Services' ESA implementing regulations define "jeopardize the continued existence of" to mean: "...to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species."[8] Section 7(a)(2)'s requirement that Federal agencies avoid jeopardizing the continued existence of listed species is often referred to as the "jeopardy standard."[9] The ESA likewise requires that Federal agencies refrain from adversely modifying designated critical habitat.[10] The Services' ESA implementing regulations define the term "destruction or adverse modification" of critical habitat to mean:

> . . . a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical.[11]

A species is listed as endangered if it is in danger of extinction throughout all or a significant portion of its range.[12] A species is listed as threatened if it is likely to become endangered within the foreseeable future.[13] Listing a species under the ESA therefore reflects a concern for a species' continued existence—the concern is immediate for endangered species and less immediate, but still real, for threatened species. The purpose of the ESA is to provide a means whereby the ecosystems upon which listed species depend may be conserved, such that the species no longer require the protections of the ESA and can be delisted.[14] This constitutes "recovery" under the ESA.[15] Recovery, then, represents a state in which there are no serious concerns for the survival of the species.[16]

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[8] 50 CFR § 402.02 (1999).

[9] *See* M.J. Bean and M.J. Rowland, *The Evolution of National Wildlife Law. Third Edition.* Praeger Publishers, Westport, Connecticut, pp. 240, 253 & 260 (1997).

[10] 16 USC § 15536(a)(2) (1988).

[11] 50 CFR § 402.02 (1999).

[12] 16 USC § 1532(6) (1988).

[13] 16 USC § 1532(20) (1988).

[14] *See, e.g.*, 16 USC § 1532(3) (1988) (defining the term "conserve"); 16 USC § 1531 (b) (1988) (stating the purpose of the ESA).

[15] *See, e.g.*, 16 USC § 1533(f)(1) (1988) (describing the purpose of recovery plans).

[16] NMFS, *Memorandum from R.S. Waples, NMFS, to the Record* (1997).

Impeding a species' progress toward recovery exposes it to additional risk, and so reduces its likelihood of survival. Therefore, in order for an action to not "appreciably reduce" the likelihood of survival, it must not prevent or appreciably delay recovery. Salmon survival in the wild depends upon the proper functioning of certain ecosystem processes, including habitat formation and maintenance. Restoring functional habitats depends largely on allowing natural processes to increase their ecological function, while at the same time removing adverse impacts of current practices.[17] Along these lines, the courts have recognized that no bright line exists in the ESA regarding the concepts of survival and recovery.[18] Likewise, available scientific information concerning habitat processes and salmon population viability indicates no practical differences exist between the degree of function essential for long-term survival and that necessary to achieve recovery.[19]

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[17] Stouder et al., *Pacific Salmon and Their Ecosystems: Status and Future Options*, Chapman and Hall, New York, New York (1997).

[18] *Idaho Department of Fish and Game v. NMFS,* 850 F.Supp. 886 (D. OR 1994) (discussing NMFS' biological opinion concerning the Federal Columbia River Hydropower System).

[19] *See* 51 Fed. Reg. 19,926 (1982). In the preamble to the § 7 consultation regulations, the Services recognized that in some cases, no distinction between survival and recovery my exist, stating "If survival is jeopardized, recovery is also jeopardized...it is difficult to draw clear-cut distinctions" [between survival and recovery].

III. Organization of Endangered Species Act § 7 Analyses

In conducting analyses of habitat-altering actions under § 7 of the ESA, NMFS uses the following steps: (1) Consider the status and biological requirements of the affected species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species; (4) consider cumulative effects; (5) determine whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of species survival in the wild or adversely modify its critical habitat. If jeopardy or adverse modification is found, NMFS must identify reasonable and prudent alternatives to the action if they exist.

The analytical framework described above is consistent with the Services' joint ESA § 7 Consultation Handbook[20] and builds upon the Handbook framework to better reflect the scientific and practical realities of salmon conservation and management on the West Coast. Below we describe this analytical framework in detail.

A. Describe the Affected Species' Status and Define its Biological Requirements.

1. Identify the Affected Species and Describe its Status

The first step in conducting this analysis is to identify listed species, and when known, populations of listed species, that may be affected by the proposed action. Under the ESA, a taxonomic species may be defined as a "distinct population segment."[21] The NMFS has established a policy that describes such "distinct population segments" as Evolutionarily Significant Units (ESUs).[22] An ESU is a population or group of populations that is substantially reproductively isolated from other conspecific populations and represents an important component in the evolutionary legacy of the species.[23] In implementing the ESA, NMFS has established ESUs as the listing unit for salmon under its jurisdiction. Therefore, for purposes of jeopardy determinations, NMFS considers whether a proposed action will jeopardize the

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[20] *See* FWS and NMFS, *supra* note 5.

[21] 16 USC § 1532(16) (1988).

[22] *See* 56 Fed. Reg. 58,618 (1991).

[23] R.S. Waples, *Definition of "Species" Under the Endangered Species Act: Application to Pacific Salmon*, National Marine Fisheries Service (1991).

continued existence of the affected ESU or adversely modify its critical habitat.[24]

When affected species and populations have been identified, NMFS considers the relative status of the listed species, as well as the status of populations in the action area. This may include parameters of abundance, distribution, and trends in both. Various sources of information exist to define species and population status. The final rule listing the species or designating its critical habitat is a good example of this type of information. Species' status reviews and factors for decline reports may also provide relevant information for this section. When completed, recovery plans and associated reports will provide a basis for determining species status in the action area.

2. Define the Affected Species' Biological Requirements

The listed species' biological requirements may be described in a number of different ways. For example, they can be expressed in terms of population viability using such variables as a ratio of recruits to spawners, a survival rate for a given life stage (or set of life stages), a positive population trend, or a threshold population size. Biological requirements may also be described as the habitat conditions necessary to ensure the species' continued existence (*i.e.*, functional habitats) and these can be expressed in terms of physical, chemical, and biological parameters. The manner in which these requirements are described varies according to the nature of the action under consultation and its likely effects on the species.

However species' biological requirements are expressed—whether in terms of population variables or habitat components—it is important to remember that there is a strong causal link between the two: actions that affect habitat have the potential to affect population abundance, productivity, and diversity; these effects are particularly noticeable when populations are at low levels—as they are now in every listed ESU. The importance of this relationship is highlighted by the fact that freshwater habitat degradation is identified as a factor of decline in every salmon listing on the West Coast.[25]

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[24] NMFS has recognized that in many cases ESUs contain a significant amount of genetic and life history diversity. Such diversity is represented by independent salmon populations that may inhabit river basins or major sub-basins within ESUs. In light of the importance of protecting the biological diversity represented by these populations, NMFS considers the effects of proposed actions on identifiable, independent salmon populations in judging whether a proposed action is likely to jeopardize the ESU as a whole.

[25] *See, e.g.*, 57 Fed. Reg. 14,653 (April 22, 1992) (Snake River spring/summer and fall chinook); 62 Fed. Reg. 24,588 (May 6, 1997) (Southern Oregon/Northern California coho); 63 Fed. Reg. 13,347 (March 18, 1998) (Lower Columbia River and Central Valley steelhead).

Habitat-altering actions continue to affect salmon population viability, frequently in a negative manner.[26] However, it is often difficult to quantify the effects of a given habitat action in terms of its impact on biological requirements for individual salmon (whether in the action area or outside of it). Thus it follows that while it is often possible to draw an accurate picture of a species' rangewide status—and in fact doing so is a critical consideration in any jeopardy analysis—it is difficult to determine how that status may be affected by a given habitat-altering action. Given the current state of the science, usually the best that can be done is to determine the effects an action has on a given habitat component and, since there is a direct relationship between habitat condition and population viability, extrapolate to the impacts on the species as a whole. Thus, by examining the effects a given action has on the habitat portion of a species' biological requirements, NMFS has a gauge of how that action will affect the population variables that constitute the rest of a species' biological requirements and, ultimately, how the action will affect the species' current and future health.

Ideally, reliable scientific information on a species' biological requirements would exist at both the population and the ESU levels, and effects on habitat should be readily quantifiable in terms of population impacts. In the absence of such information, NMFS' analyses must rely on generally applicable scientific research that one may reasonably extrapolate to the action area and to the population(s) in question. Therefore, for actions that affect freshwater habitat, NMFS usually defines the biological requirements in terms of a concept called properly functioning condition (PFC). Properly functioning condition is the sustained presence of natural[27] habitat-forming processes in a watershed (*e.g.*, riparian community succession, bedload transport, precipitation runoff pattern, channel migration) that are necessary for the long-term survival of the species through the full range of environmental variation. PFC, then, constitutes the habitat component of a species' biological requirements. The indicators of PFC vary between different landscapes based on unique physiographic and geologic features. For example, aquatic habitats on timberlands in glacial mountain valleys are controlled by natural processes operating at different scales and rates than are habitats on low-elevation coastal rivers.

In the PFC framework, baseline environmental conditions are described as "properly

[26] *See* NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996).

[27] The word "natural" in this definition is not intended to imply "pristine," nor does the best available science lead us to believe that only pristine wilderness will support salmon. The best available science does lead us to believe that the level of habitat function necessary for the long-term survival of salmon (PFC) is most reliably and efficiently recovered and maintained by simply eliminating anthropogenic impairments, and does not usually require artificial restoration. *See* Rhodes et. al., *A Coarse Screening Process for Potential Application in ESA Consultations.* Columbia River Inter-Tribal Fish Commission, Portland, Oregon, pp. 59-61, (1994); National Research Council, *Upstream: Salmon and Society in the Pacific Northwest. National Research Council*, National Academy Press, Washington, D.C., p. 201 (1996).

functioning," "at risk," or "not properly functioning." If a proposed action would be likely to impair[28] properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it will usually be found likely to jeopardize the continued existence of the species or adversely modify its critical habitat or both, depending upon the specific considerations of the analysis. Such considerations may include for example, the species' status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of the available information.

Since lotic[29] habitats are inherently dynamic, PFC is defined by the persistence of natural processes that maintain habitat productivity at a level sufficient to ensure long-term survival. Although the indicators used to assess functioning condition may entail instantaneous measurements, they are chosen, using the best available science, to detect the health of underlying processes, not static characteristics. "Best available science" advances through time; this advance allows PFC indicators to be refined, new threats to be assessed, and species status and trends to be better understood. The PFC concept includes a recognition that natural patterns of habitat disturbance will continue to occur. For example, floods, landslides, wind damage, and wildfires will result in spatial and temporal variability in habitat characteristics, as will anthropogenic perturbations.

[28] In this document, to "impair" habitat means to reduce habitat condition to the extent that it does not fully support long-term salmon survival and therefore "impaired habitat" is that which does not perform that full support function. Note that "impair" and "impaired" are not intended to signify any and all reduction in habitat condition.

[29] Running water.

B. Evaluate the Relevance of the Environmental Baseline in the Action Area to the Species' Current Status.

The environmental baseline represents the current basal set of conditions to which the effects of the proposed or continuing action would be added. It "includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early § 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process."[30]

The environmental baseline does not include any future discretionary Federal activities (that have not yet undergone ESA consultation) in the action area. The species' current status is described in relation to the risks presented by the continuing effects of all previous actions and resource commitments that are not subject to further exercise of Federal discretion. For a new project, the environmental baseline consists of the conditions in the action area that exist before the proposed action begins. For an ongoing Federal action, those effects of the action resulting from past unalterable resource commitments are included in the baseline, and those effects that would be caused by the continuance of the proposed action are then analyzed for determination of effects.

The reason for determining the species' status under the environmental baseline (without the effects of the proposed or continuing action) is to better understand the relative significance of the effects of the action upon the species' likelihood of survival and chances for recovery. Thus if the species' status is poor and the baseline is degraded at the time of consultation, it is more likely that any additional adverse effects caused by the proposed or continuing action will be significant.

The implementing regulations specify that the environmental baseline of the area potentially affected by the proposed action should be used in making the jeopardy determination. Consequently, delineating the action area for the proposed or continuing action is one of the first steps in identifying the environmental baseline. For the lotic environs typical of salmon habitat-related consultations, a watershed or sub-basin geographic unit (and its downstream environs) is usually a logical action area designation. Most habitat effects are carried downstream readily, and many travel upstream as well (*e.g.*, channel downcutting). Moreover, watershed divides

[30] *See* 50 CFR § 402.02 (1999) (definition of "effects of the action"). Action area is defined by the consultation regulations (50 CFR 402.02) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

provide clear boundaries for analyzing the cumulative effects of multiple independent actions.[31]

C. Determine the Effects of the Action on the Species.

In this step of the analysis, NMFS examines the likely effects of the proposed action on the species and its habitat within the context of the its current status and existing environmental baseline. The analysis also includes an analysis of both direct and indirect effects of the action. "Indirect effects" are those that are caused by the action and are later in time but are still reasonably certain to occur. They include effects on species or critical habitat of future activities that are induced by the action subject to consultation and that occur after the action is completed. The analysis also takes into account direct and indirect effects of actions that are interrelated or interdependent with the proposed action. "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration.

NMFS may use either or both of two independent techniques in assessing the impact of a proposed action. First, NMFS may consider the impact in terms of how many listed salmon will be killed or injured during a particular life stage and gauge the effects of that take's effects on population size and viability. Alternatively, NMFS may consider the impact on the species' freshwater habitat requirements, such as water temperature, substrate composition, dissolved gas levels, structural elements, etc. This second technique is especially useful for habitat-related analyses because, while many cause and effect relationships between habitat quality and population viability are well known,[32] they do not lend themselves to meaningful quantification in terms of fish numbers. Consequently, while this second technique does not directly assess the effects of actions on population condition, it indirectly considers this issue by evaluating existing habitat conditions in light of habitat conditions known to be conducive to salmon conservation.

Though there is more than one valid analytical framework for determining effects, NMFS usually uses a matrix of pathways and indicators to determine whether proposed actions would further damage impaired habitat or retard the progress of impaired habitat toward properly functioning condition. For the purpose of guiding Federal action agencies in making effects determinations,

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[31] National Research Council, *Upstream: Salmon and Society in the Pacific Northwest. National Research Council*, National Academy Press, Washington, D.C., pp. 34, 213 & 359 (1996).

[32] *See* Spence et al., *An Ecosystem Approach to Salmonid Conservation*, ManTech Environmental Research Services Corporation, Corvallis, Oregon (1996).

NMFS has developed and distributed a document detailing this method.[33] This document is discussed in more detail below. The levels of effects, or effects determinations, are defined[34] as:

"No effect." Literally no effect whatsoever. No probability of any effect. The action is determined to have "no effect" if there are no proposed or listed salmon and no proposed or designated critical habitat in the action area or downstream from it. This effects determination is the responsibility of the action agency to make and does not require NMFS review.

"May affect, not likely to adversely affect." Insignificant, discountable, or beneficial effects. The effect level is determined to be "may affect, not likely to adversely affect" if the proposed action does not have the potential to hinder attainment of relevant properly functioning indicators and has a negligible (extremely low) probability of taking proposed or listed salmon or resulting in the destruction or adverse modification of their habitat. An insignificant effect relates to the size of the impact and should never reach the scale where take occurs.[35] A "discountable effect" is defined as being so extremely unlikely to occur that a reasonable person cannot detect, measure, or evaluate it. This level of effect requires informal consultation, which consists of NMFS concurrence with the action agency's determination.

"May affect, likely to adversely affect." Some portion or aspect of the action has a greater than insignificant probability of having a detrimental effect upon individual organisms or habitat. Such detrimental effect may be direct or indirect, short- or long-term. The action is "likely to adversely affect" if it has the potential to hinder attainment of relevant properly functioning indicators, or if there is more than a negligible probability of taking proposed or listed salmon or resulting in the destruction or adverse modification of their habitat. This determination would apply when the overall effect of an action has short-term adverse effects even if the overall long-term effect is beneficial. In such instances, NMFS conducts a

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[33] *See* NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996).

[34] These definitions are adapted from those found in NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996), and; U.S. Fish and Wildlife Service and National Marine Fisheries Service., *Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.* U.S. Government Printing Office, Washington, D.C. (1998)

[35] "Take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in such conduct." 16 USC §1532(19) (1988).

jeopardy analysis.

The above effects determinations are applicable to individual fish, including fry and embryos. The MPI should be applied at spatial scales appropriate to the proposed action so that its habitat effects on individuals are fully taken into account. For example, if any of the indicators in the MPI are thought to be degraded by the proposed action to the extent that take of an individual fish results, the action is determined to be "may affect, likely to adversely affect." For actions that are likely to adversely affect, NMFS must conduct a jeopardy analysis and render a biological opinion resulting in one of the conclusions below:

"Not likely to jeopardize" and/or "Not likely to result in the destruction or adverse modification of critical habitat." The action does not appreciably reduce the likelihood of species survival and recovery or result in the destruction or adverse modification of its critical habitat.

"Likely to jeopardize" and/or "Likely to result in the destruction or adverse modification of critical habitat." The action appreciably reduces the likelihood of species survival and recovery or results in the destruction or adverse modification of its critical habitat.

D. Consider Cumulative Effects in the Action Area.

The ESA implementing regulations define "cumulative effects" as those effects caused by future projects and activities unrelated to the action under consideration (not including discretionary Federal actions) that are reasonably certain to occur within the action area.[36] Since all future discretionary Federal actions will at some point be subject to § 7 consultation, their effects will be considered at that time and are not included in cumulative effects analysis.

[36] 50 CFR § 402.02 (1999).

E. Jeopardy Determinations.

In this step of the analysis, NMFS determines whether (a) the species can be expected to survive, with an adequate potential for recovery, under the effects of the proposed or continuing action, the environmental baseline and any cumulative effects; and (b) whether the action will appreciably diminish the value of critical habitat for both the survival and recovery of the species. In completing this step of the analysis, NMFS determines whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the continued existence of the listed species or result in destruction or adverse modification of critical habitat.

For the jeopardy determination, NMFS uses the consultation regulations and the MPI analysis method to determine whether actions would further degrade the environmental baseline or hinder attainment of PFC at a spatial scale relevant to the listed ESU. That is, because salmon ESUs typically consist of groups of populations that inhabit geographic areas ranging in size from less than ten to several thousand square miles (depending on the species), the analysis must applied at a spatial resolution wherein the actual effects of the action upon the species can be determined.

The analysis takes into account the species' status because determining the impact upon a species' status is the essence of the jeopardy determination. Depending upon the specific considerations of the analysis, actions that are found likely to impair currently properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat towards PFC at the population or ESU scale will generally be determined likely to jeopardize the continued existence of listed salmon, adversely modify their critical habitat, or both. Specific considerations include whether habitat condition was an important factor for decline in the listing decision, changes in population or habitat conditions since listing, and any new information that has become available.

If NMFS anticipates take of listed salmon incidental to the proposed action, the biological opinion is accompanied by an incidental take statement with reasonable and prudent measures to minimize the impact of such take, and non-discretionary terms and conditions for implementing those measures. Discretionary conservation recommendations may also accompany the biological opinion to assist action agencies further the purposes of habitat and species conservation specified in §§ 7(a)(1) and 7(a)(2).

F. Identify reasonable and prudent alternatives to a proposed or continuing action that is likely to jeopardize the continued existence of the listed species.

If the proposed or continuing action is likely to jeopardize the listed species or destroy or adversely modify critical habitat, NMFS must identify reasonable and prudent alternatives that comply with the requires of § 7(a)(2) and with the applicable regulations. The reasonable and prudent alternative must be consistent with the intended purpose of the action, consistent with the action agency's legal authority and jurisdiction, and technologically and economically feasible. At this stage of the consultation, NMFS will also indicate if it is unable to develop a reasonable and prudent alternative.

IV. Application Tools Useful in Conducting § 7 Analyses - The Matrix

As previously mentioned, NMFS has developed an analytic methodology to help determine the environmental effects a given action will have by describing an action's effects on PFC.[37] This document includes a *Matrix of Pathways and Indicators* (MPI; often called "The Matrix,") and a dichotomous key for making effects determinations based on the condition of the environmental baseline and the likely effects of a given project. The MPI helps the action agency and NMFS describe current freshwater habitat conditions, determine the factors limiting salmon production, and identify sensitive areas and any risks to PFC. This document only *helps* make effects determination, it does not describe jeopardy criteria per se.

The pathways for determining the effects of an action are represented as six conceptual groupings (*e.g.*, water quality, channel condition, and dynamics) of 18 habitat condition indicators (*e.g.*, temperature, width/depth ratio). Default indicator criteria[38] (mostly numeric, though some are narrative) are laid out for three levels of environmental baseline condition: properly functioning, at risk, and not properly functioning. The effects of the action upon each indicator is classified by whether it will restore, maintain, or degrade the indicator.

The MPI provides a consistent, but geographically adaptable, framework for effects determinations. The pathways and indicators, as well as the ranges of their associated criteria, are amenable to alteration through the process of watershed analysis. The MPI, and variations on it, are widely used in § 7 consultations. The MPI is also used in other venues to determine baseline conditions, identify properly functioning condition, and estimate the effects of individual management prescriptions. This assessment tool was developed for forestry activities. NMFS is working to adapt it for other types of land management, and for larger spatial and temporal scales.

For practical purposes, the MPI analysis must sometimes be applied to geographic areas smaller than a watershed or basin due to a proposed action's scope or geographic distribution. These circumstances necessarily reduce analytic accuracy because the processes essential to aquatic habitats extend continuously upslope and downslope, and may operate quite independently

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[37] NMFS, *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (MPI) (1996).

[38] The unmodified "matrix" uses ranges of values for indicators that are generally applicable between species and across the geographic distribution of salmon. The indicators can be, and have been, modified for more specific geographic and species applications.

between drainages.[39] Such loss of analytic accuracy should typically be offset by more conservative management practices in order to achieve parity of risk with the watershed approach. Conversely, a watershed approach to habitat conservation provides greater analytic certainty, and hence more flexibility in management practices.

[39] L. B. Leopold, *A View of the River*, Harvard University Press, Cambridge, Massachusetts, chapter 1 (1994).

V. Conclusion

The NMFS has followed regulations under §§ 7 and 10 of the ESA to develop an analytical procedure used to consistently assess whether any proposed action would jeopardize or conserve federally protected species. There is a legacy of a more than a century of profound human alterations to the Pacific coast drainages inhabited by salmon.[40] The analytical tool described as the MPI enables proposed actions to be assessed in light of the species current status, the current conditions, and expected effects of the action. Proposed actions that fail to conserve fish and their habitats as initially proposed can be redesigned to avoid jeopardy and begin to restore watershed processes. Conservation of listed salmon will depend largely on the recovery of watershed processes that furnish their aquatic habitat.

[40] *See* Cone and Ridlington, *The Northwest Salmon Crisis, a Documentary History.* Oregon State University Press, Corvallis, Oregon, pp. 12-21 & 154-160 (1996); W. Nehlsen *et al.*, *Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington,* Fisheries, Vol.16(2), pp. 4-21 (1991).